REPORT RESUMES

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READING ASSIGNMENT OUTLINES FOR INDUSTRIAL TECHNOLOGY I, THE WORLD OF CONSTRUCTION.

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THE PURPOSE OF THIS ATTACHMENT TO THE FINAL REPORT OF THE FIRST PHASE OF THE INDUSTRIAL ARTS CURRICULUM PROJECT (VT 003 145) IS TO PRESENT OUTLINES OF DAILY READING ASSIGNMENTS FOR A 170-DAY COURSE IN CONSTRUCTION AT THE SEVENTH GRADE LEVEL. UNITS ARE -- (1) MAN REMAKES HIS WORLD, (2) MANAGEMENT IN CONSTRUCTION, (3) PRODUCTION IN CONSTRUCTION, (4) WORKING IN CONSTRUCTION, AND (5) COMMUNITY DEVELOPMENT. A TYPICAL DAY COVERS "CHANGING THE FORM OF MATERIALS" WITH THE FOLLOWING MAJOR DIVISIONS -- (1) SHAPING THE ENVIRONMENT, (2) WORKER CONTROL OVER MATERIALS, (3) PRACTICES OF MATERIAL HANDLING, (4) PRACTICES OF MATERIAL SEPARATING, (5) PRACTICES OF COMBINING MATERIALS, AND (6) PRACTICES OF FORMING MATERIALS. (OTHER ATTACHMENTS ARE A (VT 003 203), B (VT 003 202), AND C (VT 003 210). (EM)

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ATTACHMENT D

IACP

industrial arts curriculum project

VT003304

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READING ASSIGNMENT OUTLINES
FOR
INDUSTRIAL TECHNOLOGY I
THE WORLD OF CONSTRUCTION

Ohio State Univ., Columbus.
Illinois Univ., Champaign.

Industrial Arts Curriculum Project
Preliminary Draft
August 1966

PREFACE: TO THE STUDENT

I. Purposes of Industrial Arts
   A. Understand the concepts, principles, generalizations, problems, and strategies of industrial technology;
   B. Have an interest in and an appreciation for industry as that element of the economic system that provides industrial material goods for the satisfaction of human wants for those goods;
   C. Demonstrate knowledge and skills that will be useful in life situations of occupational, recreational, consumer, and socio-cultural significance.

II. Purposes of Course Content
   A. Man remakes his world
      1. Aware of man's practices in industry in changing the forms of materials to satisfy human wants for material products.
      2. Aware of the historical significance of the construction industry in society.
      3. Aware of the concepts, principles, generalizations, problems, and strategies of construction technology.
   B. Management in construction
      1. Aware of how man manages: plans, organizes, and controls men and materials to satisfy human wants.
      2. Able to perform selected management practices in planning, organizing, and controlling men and materials in the field of construction.
      3. Able to gain knowledge, comprehend concepts, apply knowledge to management practices, analyze management procedures, synthesize management processes, and evaluate the effects of management upon given situations.
   C. Production in construction
      1. Perform selected construction practices using tools and materials common to the construction industry.
      2. Develop understandings and appreciations through experiencing practices and applying knowledge to various real and simulated situations.
      3. Associate and discriminate between practices used in on-the-site construction of a structure.
      4. Gain knowledge, comprehend concepts, apply knowledge to production procedures, analyze production processes, synthesize production practices, and evaluate the results of production in various situations.

D. Working in the construction phase of industry
  1. Gain knowledge and appreciation of the practices of hiring, training, working, advancing, and retiring.
  2. Be able to identify, associate and discriminate between occupations in the construction industry.
  3. Gain experience in performing the practices of personnel relations.

E. Community development
  1. Gain satisfaction of achievement by being able to manipulate his knowledge and skills to investigate factors involved in regional development of constructed works as they relate to an environmental setting.

F. A construction project
  1. Gain appreciation and understanding of how man changes the forms of materials to satisfy human wants through construction by conceptualizing ideas, discovering principles, forming generalizations, solving problems, and determining strategies typical of construction technology.

III. Use of Course Materials

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UNIT VI A CONSTRUCTION PROJECT

UNIT I

MAN REMAKES HIS WORLD

TOOLS AND SOCIETY

Reading Assignment
Day 2

I. Introduction
   A. Only by the creation of tools was man able to advance
   B. Results of tool making established a cause-effect situation which resulted in man's social system
   C. Reading assignment traces the evolution of man's social system as affected by man's tool making

II. Emergence of Man
   A. Man's life was first characterized by:
      1. scavenger hunting
      2. living in cave entrances by day and fields and trees by night
      3. using sticks, stones, animal bones, and broken pebble stones for tools in their natural state
   B. Early man and his created tools
      1. The first man was handicapped by:
         a. lack of comparable strength to other creatures
         b. inability to fight as effectively as other creatures
         c. need to spend more time teaching his children
      2. These handicaps forced men to begin tool making and tool selecting. Tool making and selecting became that physical and mental exercise which developed men's conceptual thinking and development of a social system
      3. Only by the creation of tools was man able to advance
   C. Beginning approximately 500,000 years ago, man began to create tools from stone and wood and to make discoveries
      1. His first attempts at tool making in stone resulted in the all-purpose fist axe.
      2. Energy to use the stone and wood tools was supplied by human muscle power
      3. Man discovered fire for warmth and cooking, but long before the discovery of fire man:
         a. learned to speak
         b. learned to live in groups
         c. shared food
         d. educated his children
         e. discovered that death is inevitable and, in order to bear this burden, he began to believe in life after death beginning the religious institution.

Reading Assignment
Day 2 (continued)

III. Man's expansion and specialization began 40,000 to 50,000 years ago
   A. Once man learned to cook food the eating time was cut down from several hours to two hours a day permitting:
      1. spending more time hunting and fishing
      2. perfecting techniques in tool making
      3. exploring and expanding his population over earth
      4. pursuing more cultural pursuits
         a. arts
         b. personal adornment
         c. rituals
      5. inventing the bow and arrow and domestication of dog
   B. The chain of cause and effect beginning with man's creation of tools resulted in:
      1. development in thinking
      2. living in larger groups
      3. more education needed for his children
      4. increased travel
      5. development of communication, trading, and specialization in tool making

IV. Man having survived and dominated other creatures plus creating tools moved into new ages in which inventions and culture were the chief guide to his activities
   A. Bronze Age beginning 6,500 years ago
      1. depended upon three basic inventions:
         a. forced-draft charcoal-fed furnace
         b. rotating shaft
         c. writing
      2. was the age of invention of new occupations
         a. farming
         b. herd tending
         c. scribes
         d. craftsmen
         e. merchants
      3. was the time man began to live in villages
      4. international trade and cultural borrowing increasd
      5. institutions created by man grew in size and complexity of detail
   B. Iron Age beginning 3,400 years ago
      1. Ordinary man replace stone tools used in Bronze Age with metal tools
      2. Riding horse and camel extended men's powers of speed, range of travel, communication, and volume of trade
      3. 26-letter phonetic alphabet and money (coins) were invented

Reading Assignment
Day 2 (continued)

4. Major inventions of the Iron Age included:
    a. iron and steel
    b. rotary grain mill
    c. the screw
    d. the toothed wheel or gear
    e. water turbine
    f. wind mill
    g. gun powder and cannon
    h. paper making and printing
5. The results of these inventions:
    a. wise men, freed from labor by slaves, conceived the idea of order and unity in the universe
    b. great civilizations arose rivaling our present civilization
    c. political institution became universal
    d. middle class arose
    e. craftsmen organized themselves into guilds and corporations
    f. formal educational institutions were established
    g. people joined social organizations

PRODUCING ECONOMIC GOODS

Reading Assignment
Day 3

I. Introduction
    A. The Economic Institution is one of the fundamental institutions of human society. Its function is to satisfy man's wants for economic goods
    B. Economic goods are material and non-material

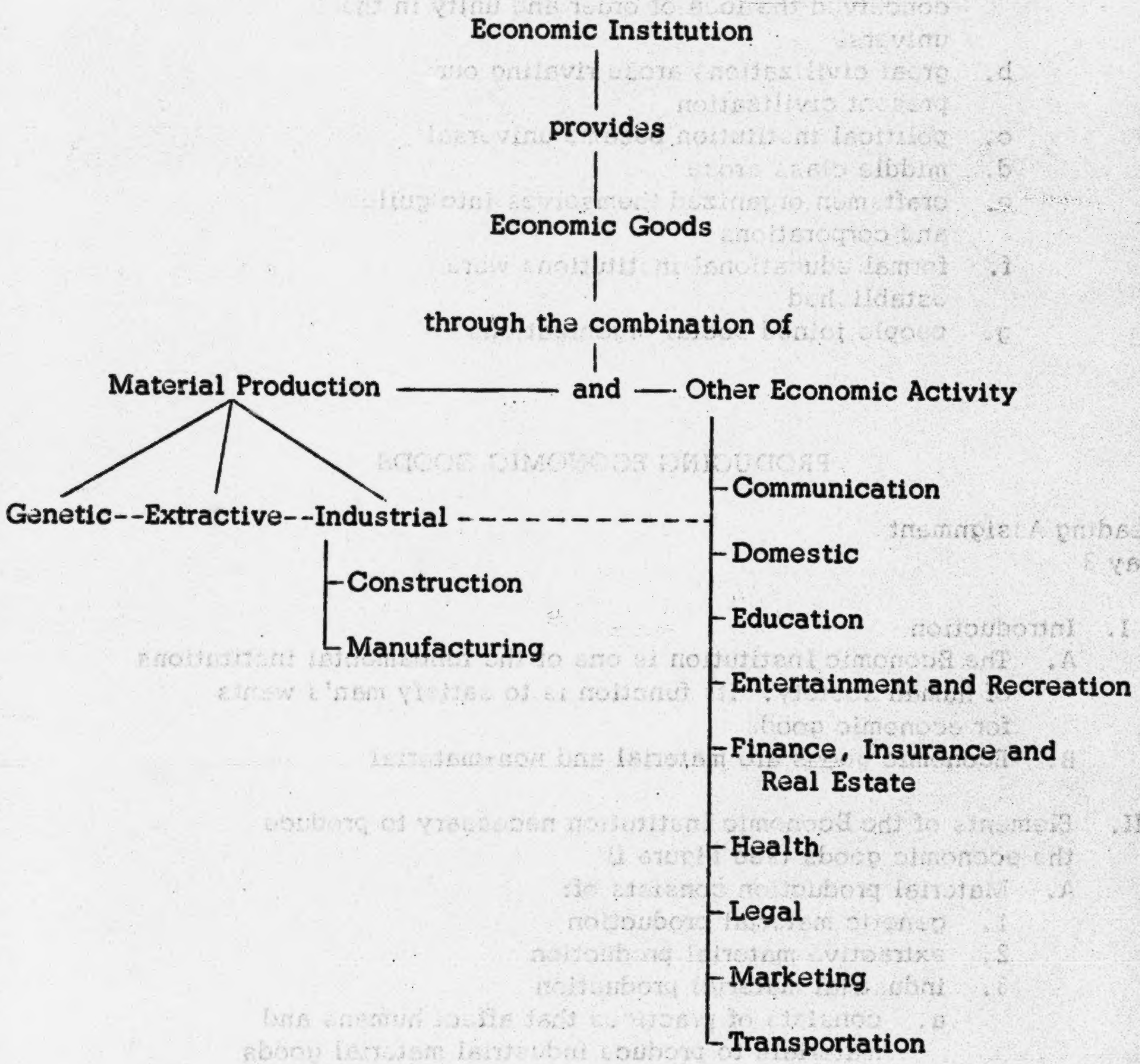
II. Elements of the Economic Institution necessary to produce the economic goods (see Figure I)
    A. Material production consists of:
        1. genetic material production
        2. extractive material production
        3. industrial material production
            a. consists of practices that affect humans and materials to produce industrial material goods
            b. industrial material goods are produced by manufacturing and construction

Reading Assignment
Day 3 (continued)

B. Non-material production consists of such economic activity as:
   1. legal
   2. marketing
   3. finance
   4. others

Figure I

ELEMENTS OF THE ECONOMIC INSTITUTION


Economic Institution
provides
Economic Goods
through the combination of
Material Production
and
Other Economic Activity
Genetic
Extractive
Industrial
Construction
Manufacturing
Communication
Domestic
Education
Entertainment and Recreation
Finance, Insurance and Real Estate
Health
Legal
Marketing
Transportation

Reading Assignment
Day 3 (continued)

III. Concepts to Know
  A. Material production within the Economic Institution consists of two concepts:
    1. historical equation of man's material welfare, MMW = NR + HE X T
      a. man's material welfare
      b. natural resources
        (1) climate, soil, water
        (2) animals, forests
        (3) minerals, metals
      c. human energy
      d. tools the one thing which nature did not provide
    2. Methods of material change:
      a. combining
      b. separating
      c. forming
  B. The relationship between material production and other economic activity can be expressed more fully by the equation--
  Man's Material Welfare = Natural Resources + Human Energy + Capital + Finance + Information + Energy

INDUSTRY IN THE ECONOMIC SYSTEM

Reading Assignment
Day 4

I. Evolution of Industry
  A. Prior to 1800 almost all work and products were produced by tools and simple machines powered by animal power (including human)
  B. During 18th and 19th centuries man discovered how to assemble tools and simple machines to make products
  C. Modern industry was the change from the use of tools and simple machines powered by animal to machines powered by energy other than animal power.

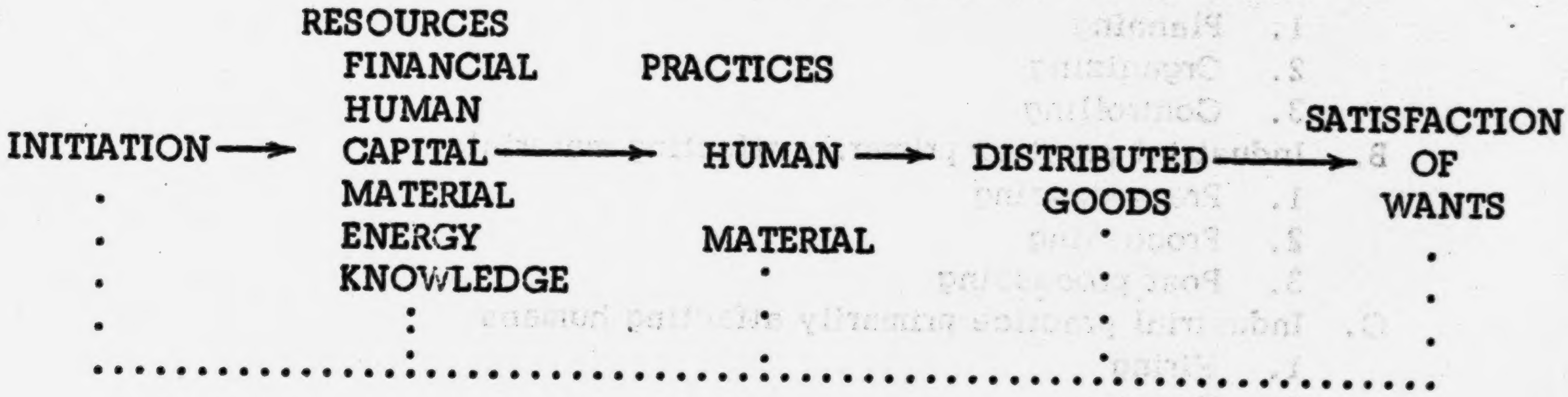
D. Modern industry by its evolution and increasing industrial material production affected society:
   1. created the factory system
   2. virtual elimination of the craftsman, changing him to a factory worker under factory rules
   3. caused increased division of labor and specialization of function
   4. created a working-class with its organizations
   5. redistribution of wealth and ownership
   6. shift in economic and political power
   7. removed large numbers of people from farm life disrupting a life which had existed for thousands of years

II. Industry
A. Industry is that subcategory of the Economic Institution which:
   1. substantially changes the form of material in response to man's wants for material goods
   2. provides the knowledge of how to efficiently use and service its material goods
   3. produces those goods used in other economic activity
B. Only manufacturing and construction are engaged in the forming of materials
C. Other economic activity operate and control these material goods to provide non-material production
D. To produce any good (material or non-material) man follows the sequence of processes which comprise the Model of the Economic System of Society (see Figure II)
   1. Initiation
   2. Resources (inputs)
      a. Financial
      b. Human
      c. Capital
      d. Material
      e. Energy
      f. Knowledge
   3. Practice
      a. Human
      b. Material
   4. Distributed goods (outputs)
   5. Satisfaction of wants

Reading Assignment
Day 4 (continued)

Figure II

MODEL OF THE ECONOMIC SYSTEM OF SOCIETY

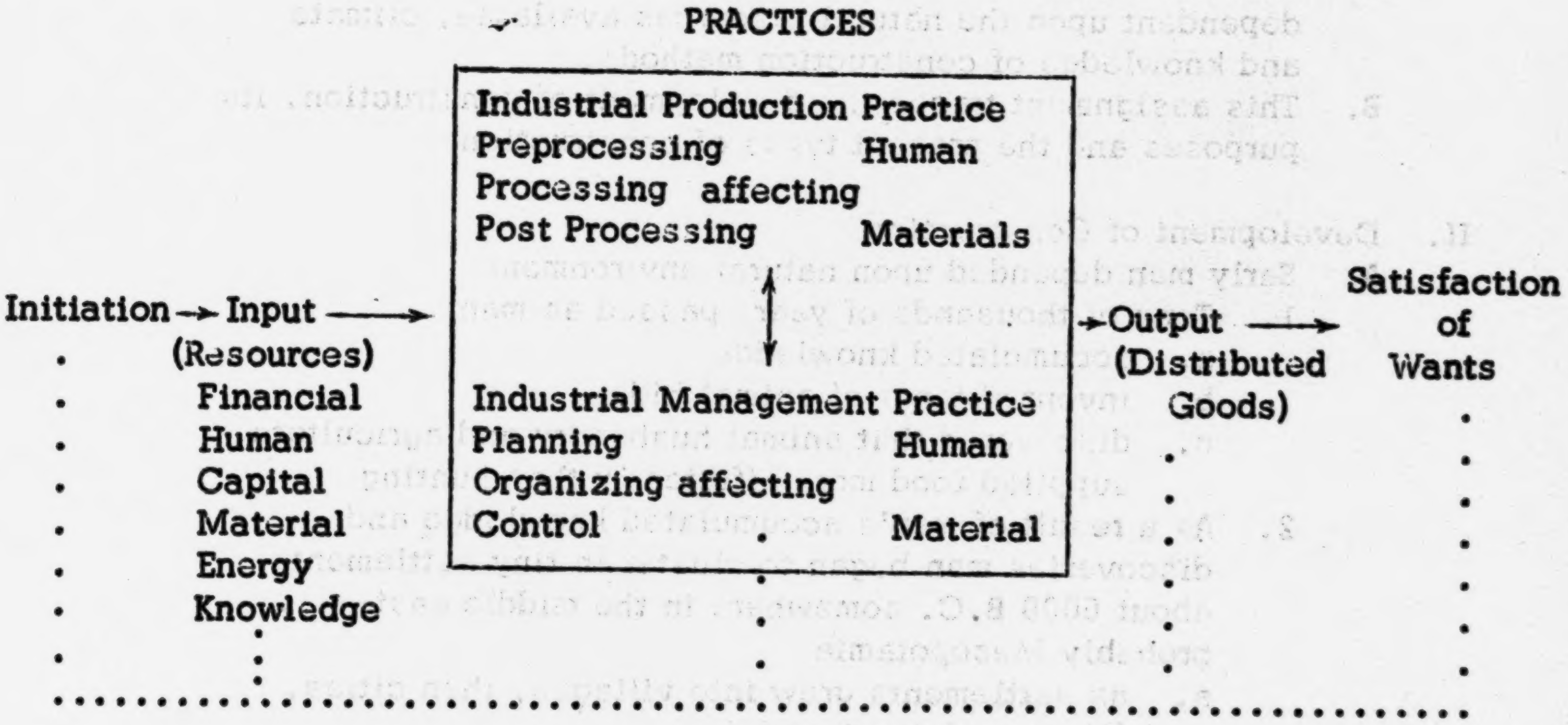

INITIATION
RESOURCES
FINANCIAL
HUMAN
CAPITAL
MATERIAL
ENERGY
KNOWLEDGE
PRACTICES
HUMAN
MATERIAL
DISTRIBUTED GOODS
SATISFACTION OF WANTS

THE TECHNOLOGY OF INDUSTRY

Reading Assignment
Day 5

I. Introduction
   A. Industry fulfills that part of the Model of the Economic System of Society labeled "Practices" (see Figure III)

Figure III


PRACTICES
Industrial Production Practice
Preprocessing
Processing
Post Processing
affecting
Human
Materials
Industrial Management Practice
Planning
Organizing
Control
affecting
Human
Material
Initiation
Input
(Resources)
Financial
Human
Capital
Material
Energy
Knowledge
Output
(Distributed Goods)
Satisfaction of Wants

   B. Practice affects humans and materials

Reading Assignment
Day 5 (continued)

- II. Practice when analyzed consists of three major divisions
  - A. Industrial management practice
    - 1. Planning
    - 2. Organizing
    - 3. Controlling
  - B. Industrial practice primarily affecting materials
    - 1. Preprocessing
    - 2. Processing
    - 3. Post processing
  - C. Industrial practice primarily affecting humans
    - 1. Hiring
    - 2. Training
    - 3. Working
    - 4. Advancing
    - 5. Retiring

STORY OF CONSTRUCTION

Reading Assignment
Day 6

- I. Introduction
  - A. The development of structures in all countries has been dependent upon the natural resources available, climate and knowledge of construction methods.
  - B. This assignment traces the development of construction, its purposes and the present types of construction
- II. Development of Construction
  - A. Early men depended upon natural environment
    - 1. Tens of thousands of years passed as man:
      - a. accumulated knowledge
      - b. invented tents of animal hide
      - c. discovered that animal husbandry and agriculture supplied food more efficiently than hunting
    - 2. As a result of man's accumulated knowledge and discoveries man began to cluster in tiny settlements about 6000 B.C. somewhere in the middle east--probably Mesopotamia
      - a. as settlements grew into villages, then cities,
        - (1) specialization arose
        - (2) among these specialists was the artisan
        - (3) the artisan by trial and error amassed a body of knowledge with which he used to build dwellings and temples and to dig canals to water his fields

B. A great center of civilization arose in the neighborhood of the Tigris and Euphrates
   1. Here city-states developed
   2. Palaces and temples were erected
   3. Embankments and levies were constructed to contain flood waters
   4. A huge dam, the Marib, was used to supply water
   5. An aqueduct supplied water to the city of Ninevah
   6. Brick sewers (4000 B.C.) were found in Ninevah
   7. Roads and bridges were built which joined the empires of Xerxes and Darius

C. In Egypt
   1. First dwellings were made of wood frame with walls and roof of reeds, lotus, and papyrus
   2. Later buildings were constructed from mud mixed with straw formed between molds and sunbaked
   3. Egyptians used Corbel system (3000 B.C.) to lay bricks and form the false arch
   4. Egyptians progressed from mud to use of stone--limestone, sandstone, and granite
   5. Egyptians used construction tools and simple machines invented by others
      a. Pulley
      b. Windlass
      c. Capstan
      d. Lever
      e. Roller

D. These middle eastern civilizations were followed and overlapped by a period of time by those of Greece and Rome
   1. Grecian civilization beginning 3000 B.C. contributed fundamental studies of physics and hydraulics and mathematical surveying upon which planned construction depended
   2. Roman civilization beginning 3000 B.C.
      a. used Grecian discoveries and inventions to their fullest use but did not make any revolutionary improvements over them
      b. first consistent and common use of concrete made from hydraulic cement which will harden under water to build
         (1) harbor developments
         (2) foundations
         (3) arches and domed ceilings
         (4) arched bridges
         (5) aqueducts
         (6) tunnels

E. Middle Ages
  1. Most spectacular achievements were the construction of great cathedrals
  2. Designed and constructed sound and beautiful bridges
  3. Developed structures to harness wind and water power
  4. There was no great change in construction methods or materials. The methods and materials were primarily those of predecessors

F. Today
  1. Structural steel has changed most construction
  2. Brick and stone keep out elements and are not vital to the structure
  3. Brick and stone are being replaced by glass
  4. Steel structures are themselves being replaced by prestressed concrete
  5. Plastics, laminates, and other recently discovered materials and knowledge are affecting construction

III. Purposes of Construction
  A. Provide access
  B. To retain
  C. Provide altitude
  D. Provide service
  E. Provide shelter

IV. Types of Construction
  A. General building construction
    1. Skyscrapers
    2. Office buildings
    3. Apartments
    4. Plants
    5. Schools
    6. Hospitals
    7. Churches
  B. Highway construction
    1. Highways
    2. Bridges
    3. Grade separations
    4. Culverts
    5. Paving
    6. Earthmoving
    7. Traffic controls
    8. Landscaping

Reading Assignment
Day 6 (continued)

C. Heavy construction
    1. Tunnels
    2. Airports
    3. Dams
    4. Missile bases
    5. Railroads
    6. Flood control projects
D. Utilities construction
    1. Pipeline installations
    2. Sanitation projects
    3. Waterworks
    4. (Other utility needs)

MAJOR CONSTRUCTION PRACTICES

Reading Assignment
Day 7

I. Introduction
    A. As explained previously the production of any economic good follows the sequence of the economic system of initiation, obtaining resources or inputs, the production practices, the output or distributed good, and the satisfaction of wants
    B. This assignment is primarily concerned with practices in management in construction and practices in production in construction
    C. Many functions in management and construction overlap in the time of their being done

II. Management in construction consists of:
    A. planning
        1. formulating
        2. researching
        3. designing
        4. developing
        5. engineering
    B. organizing
        1. structuring
        2. supplying
    C. controlling
        1. directing
        2. monitoring
        3. reporting
        4. correcting

Reading Assignment
Day 7 (continued)

III. Production in Construction
  A. Preparing the site
    1. Setting up temporary facilities
    2. Clearing the site
    3. Surveying for construction
    4. Earthworking
  B. Building the structure
    1. Setting foundations
    2. Building the major structural elements
    3. Installing circulatory systems
    4. Finishing the structure
  C. Completing the site
    1. Landscaping
    2. Removing temporary plant and facilities
  D. Post processing
    1. Repairing
    2. Altering
    3. Installing
    4. Maintaining

THE CREATION OF A BUILDING

Reading Assignment
Day 8

I. This is the story of the creation of a building from the idea to build to the finished product

II. Initiation determines:
  A. need
  B. want
  C. feasibility

III. Obtain resources or determine that they can be obtained when needed
  A. Financial
  B. Human
  C. Capital
  D. Material
  E. Energy
  F. Knowledge

Reading Assignment
Day 8 (continued)

IV. Management needed before actual material production
    A. Planning
        1. Formulating
        2. Researching
        3. Designing
        4. Developing
        5. Engineering
    B. Organizing
        1. Structuring
        2. Supplying
    C. Controlling
        1. Directing
        2. Monitoring
        3. Reporting
        4. Correcting

V. Production in Construction
    A. Preparing the site
        1. Setting up temporary facilities
            a. Providing temporary access and protection
            b. Establishing temporary shelters
            c. Providing temporary utilities
        2. Clearing the site
            a. Reducing obstacles
            b. Handling materials
        3. Surveying for construction
            a. Referencing to existing features
            b. Laying out the structure
        4. Earthworking
            a. Mobilizing equipment
            b. Earthmoving
            c. Protecting existing utilities
            d. Shaping and stabilizing earthworks
    B. Building the structure
        1. Setting foundations
            a. Making and placing forms
            b. Setting reinforcement
            c. Preparing foundation materials
            d. Handling materials
            e. Bonding
            f. Curing
            g. Removing forms
            h. Finishing foundations

Reading Assignment
Day 8 (continued)

2. Building the major structural elements
    a. Preparing materials
    b. Fabricating components and temporary forms
    c. Setting reinforcement
    d. Handling materials and components
    e. Treating
    f. Removing temporary forms
3. Installing circulatory systems
    a. Installing permanent utilities and mechanical plant
    b. Providing temporary equipment
4. Finishing the structure
    a. Enclosing the structure (rough finishing)
    b. Completing the structure (fine finishing)

C. Completing the site
    1. Landscaping
    2. Removing temporary plant and facilities

D. Post processing
    1. Repairing
    2. Altering
    3. Installing
    4. Maintaining

A MASTERPIECE OF CONSTRUCTION
"THE DAM"

Reading Assignment
Day 9

See outline of Day 8 for guide to writing the initiation and construction of "The Dam"

THE CONSTRUCTION FIELD

Reading Assignment
Day 10

I. This reading assignment attempts to answer some personal questions concerning the individual who works in the construction field.

II. What type of person enjoys working in the construction field?

III. What type of life does a person have when working in the construction field?

IV. What employment opportunities are there in the construction field?

V. What qualities and education must a person possess to succeed in the construction field?

UNIT II

MANAGEMENT IN CONSTRUCTION

INTRODUCTION TO INDUSTRIAL MANAGEMENT

Reading Assignment
Day 11

- I. Introduction
  - A. All life activity is managed
    - 1. Family affairs
    - 2. Home owned business
    - 3. Large corporation
  - B. Management activity is universal
    - 1. Agriculture example
    - 2. Business example
    - 3. Industry example
      - a. Manufacturing
      - b. Construction

- II. Management in Industry
  - A. Levels of management
    - 1. Top management
    - 2. Middle management
    - 3. All members of organization as "managers"
  - B. Role of management
    - 1. Profit motive as major goal
    - 2. Develop plans
    - 3. Implement plans
    - 4. Control plans

- III. Management Practices
  - A. Planning
    - 1. Importance of plans
    - 2. Types of plans
      - a. Short range
      - b. Long range
    - 3. Kinds of planning
      - a. Formulating
      - b. Researching
      - c. Designing
      - d. Developing
      - e. Engineering
  - B. Organizing
    - 1. Importance of organization
    - 2. Types of organization (line - staff - functional, etc.)
    - 3. Kinds of organizing
      - a. Structuring
      - b. Supplying

Reading Assignment
Day 11 (continued)

- C. Controlling
  - 1. Importance of control
  - 2. Types of control
    - a. Quality
    - b. Quantity
  - 3. Kinds of controlling
    - a. Directing
    - b. Monitoring
    - c. Reporting
    - d. Correcting

IV. Summary

INTRODUCTION TO PLANNING

Reading Assignment
Day 12

I. Introduction

II. Planning is a decision making process
- A. The forming of an idea
- B. The establishment of method

III. Planning is a creative process
- A. Designing
- B. Engineering

IV. The phases of planning are all necessary for the total product and they are listed as:
- A. formulating
- B. researching
- C. designing
- D. developing
- E. engineering

FORMULATING

Reading Assignment
Day 13

I. Introduction
   A. First step in planning
   B. Formulating gives proof that an idea is valid
      1. Idea forced into some depth
      2. Idea is tested by several people for validity
      3. Reasons for its existence are stated
   C. Elements in formulating and their relationships
      1. Determining goals
      2. Establishing specific objectives
      3. Setting policies
      4. Programming

II. Determining Goals
   A. Goals should be feasible in terms of the idea as well as the desired end result
      1. Goals limited to realistic picture of project
      2. Goals should be specifically stated but general enough in nature to allow flexibility in objectives
   B. Goals will differ as the man's position towards the project differs
      1. Contractor - profit
      2. Owner - product
      3. Architect - profit and product

III. Establishing Specific Objectives
   A. Objectives means of reading goals
   B. Objectives easier to realize
      1. More closely related to the project
      2. Set by those more familiar to the area the objective is intended
   C. Objectives determine qualitative and quantitative values for the given project

IV. Setting Policies
   A. Policies like objectives are important in terms of meeting goals
   B. Policies are of varying degrees of importance
   C. High level policies considered as a course of action
   D. Low level policies means of intermediate control

Reading Assignment
Day 13 (continued)

V. Programming
   A. Creating a structure for the program
   B. Listing phases for the project
   C. Estimation of time involved
   D. Allows rough estimates of cost and manpower required

RESEARCHING

Reading Assignment
Day 14

I. Introduction
   A. Obtaining supporting material for an idea
   B. Two ways of researching
      1. Dig out of past
      2. Create your own supporting material
   C. Profit from past experiences
   D. Researching involves:
      1. retrieving
      2. describing
      3. experimenting
      4. forecasting

II. Retrieving
   A. Referring back to history of similar construction projects
      1. General information libraries
      2. Computer storage
      3. Specified libraries
   B. Obtaining relative information pertaining to the natural elements of the project
      1. Soil tests
      2. Surveying
      3. Climate reports

III. Describing
   A. Arrange, interpret and clarify data so that it may be understood by others
   B. Brings about need for more retrieving to be done
   C. Material must be complete for total comprehension of project

Reading Assignment
Day 14 (continued)

- IV. Experimenting
  - A. Meant to lead to progress for the entire construction industry
  - B. People involved
    - 1. True experimenter
    - 2. Independent firms
    - 3. Individual industries trying to meet demand of construction industry
  - C. Recent discoveries
    - 1. Fiber-reinforced concrete
    - 2. Plastics used in construction
    - 3. Inflatable buildings

- V. Forecasting
  - A. Looking forward and predicting into a project
    - 1. Men
    - 2. Materials
    - 3. Cost
    - 4. Time
  - B. Preparing results of experimentation in terms of predicting usefulness of the discovery for the industry

INTRODUCTION TO DESIGNING

Reading Assignment
Day 26

- I. Introduction

- II. Importance of Design
  - A. Design inherent in all man made objects
  - B. Design vital element in life
    - 1. Survival through design
      - a. Life and death - bridges, roads, tunnels
      - b. Living - homes, offices
    - 2. Mental and physical aggrevations
      - a. Improper lighting
      - b. Lack of human engineering
  - C. Saarinen's three stages of design
    - 1. Unconscious: primitive - simple direct solutions
    - 2. Conscious: Greek - refinement of esthetics
    - 3. Self conscious: late renaissance up to modern movement - decoration

Reading Assignment
Day 26 (continued)

- D. Todays organic design revolution
  - 1. Emphasis: the structure itself is the strongest design element
  - 2. De-emphasis: applied decoration
  - 3. Design that brings out best in people
    - a. Not culture grabbing
    - b. Not for show

III. Characteristics of Good Design

- A. Function serves the purpose for which the object is designed
  - 1. Human wants
  - 2. Human needs
- B. Simplicity
  - 1. The most with the least
  - 2. Economy
  - 3. Efficiency
  - 4. Elimination of clutter
- C. Honesty
  - 1. To the object itself
  - 2. To the materials, process, and tools
  - 3. To the culture
- D. Appeal to the senses
  - 1. Visual
  - 2. Tactile

IV. The Design Process

- A. Planning the shaping of materials to satisfy man's needs
- B. How is it done
  - 1. Determining the basic function
  - 2. Analyzing the function to reveal various services the object is to provide
  - 3. Determining physical elements
  - 4. Organizing parts into a general framework "solution in principle"
  - 5. Conceiving alternate solutions
  - 6. Selecting final solution
  - 7. Communicating final design

DETERMINING FUNCTION - PREPARING PERFORMANCE SPECIFICATIONS

Reading Assignment
Day 27

- I. Introduction
  - A. Determining function
  - B. Preparing performance specifications
- II. Determining function
  - A. Listing activities or uses of project
    - 1. What is the structure to do for people?
      - a. Keep them warm
      - b. Keep them dry
      - c. Etc.
    - 2. What do the people want to do with this structure?
      - a. Eat
      - b. Sleep
      - c. Dance
      - d. Etc.
  - B. Information gathered by research
    - 1. Book work
    - 2. Physical analysis
  - C. Functions not always obvious
    - 1. Too obvious to see
    - 2. Hidden functions
  - D. Function - determines final design
    - 1. Dam
    - 2. Road
    - 3. Bridge
  - E. Good design accommodates all possible related functions
  - F. Functional schematics
    - 1. Relating function to each other
    - 2. Assigning values to functions
- III. Preparing Performance Specifications
  - A. Schematics relate function without regard for size or scale
    - 1. Size relationships
    - 2. Visual relationships
  - B. Each activity or function has a dimensional requirement
    - 1. Minimum requirements
      - a. Example
      - b. Example
    - 2. Designer's emphasis

CONCEIVING A SOLUTION IN PRINCIPLE - CONCEIVING ALTERNATE SOLUTIONS

Reading Assignment
Day 28

I. Introduction
   A. Conceiving a solution in principle
   B. Conceiving alternate solutions

II. Conceiving a Solution in Principle
   A. Giving a form to an idea
      1. First draft
      2. Solving no problems
   B. Growth solution
      1. Growing from schematic
      2. Growing from performance specifications
   C. Gives insight
      1. Poses problems
      2. Suggests answers
   D. First place for realistic considerations
      1. Structural system
      2. Overall visual form
      3. Economical feasibility
   E. Solutions conceived through knowing limitations

III. Conceiving Alternate Solutions
   A. Tools for design
      1. Problems
      2. Limitations
   B. Alternate solutions are attempts to solve problems within limitations
   C. Never a finished solution
      1. More problems created
      2. More refinement in detail
      3. Only a final solution

SELECTING A SOLUTION

Reading Assignment
Day 29

- I. Introduction
- II. Establish Criteria for Solution
  - A. Objectives
  - B. Requirements
  - C. Limitations
- III. Evaluate Solutions
  - A. Criteria
  - B. Value judgment
  - C. Ease of understanding
  - D. Client's preference

COMMUNICATING DESIGN SOLUTION

Reading Assignment
Day 30

- I. Introduction
- II. Rendering
  - A. Realistic appearance
  - B. Media
    - 1. Watercolor - casein
    - 2. Ink - washes
    - 3. Color pencil
    - 4. Pencil
- III. Presentation Speech
  - A. Selecting strong points and emphasizing them
  - B. Using client's ideas as basis for good points
  - C. Relate to community and other people
- IV. Argument
  - A. Know solution well
  - B. Know counterbalancing points

DEVELOPING IN THREE DIMENSIONS

Reading Assignments
Day 31

I. Introduction

II. Problem Solving
  A. Simple models
  B. Working models

III. Analysis of Design
  A. Simple models
  B. Scale models

IV. Presentation Models

V. Experimentation
  A. Full scale models
  B. Working models

INTRODUCTION TO ENGINEERING

Reading Assignment
Day 32

I. Introduction
  A. Engineering is a part of every constructed object
    1. Construction industry
      a. Bridges
      b. Dams
      c. Towers
      d. Highways
    2. Manufacturing
      a. Machines
      b. Furniture
      c. Cars
  B. Engineering necessary for the structuring of life's necessities and pleasures

II. Not to be confused with design
  A. Engineering is another look at design
  B. Engineering structures the design

Reading Assignment
Day 32 (continued)

III. Elements of Engineering
    A. Detailing design communication
    B. Detailing specifications and standards
    C. Estimating
    D. Scheduling

DETAILING DESIGN COMMUNICATION

Reading Assignment
Day 33

I. Introduction

II. Detailing the design-working drawings
    A. Entire construction project detailed
        1. Structural systems
        2. Modular design
    B. Detailing site plans
    C. Detail utilities
    D. Detailing structure itself
    E. Detailing services for the structure

III. Symbols
    A. Universal language
    B. Simplification of detailing

IV. Scale Drawings
    A. Dependent on necessary detail
    B. For ease of handling

DETAILING SPECIFICATIONS AND STANDARDS

Reading Assignment
Day 34

I. Introduction
    A. Definition
    B. Stages of:
        1. role of specifications
        2. catalog specifications
        3. mass-produced products

Reading Assignment
Day 34 (continued)

- II. Sources of Material
  - A. Building codes
    - 1. City
    - 2. State
    - 3. County
    - 4. Safety
    - 5. Specialized
  - B. American society for testing and materials ASTM

- III. Assembly and Reproduction
  - A. Old specifications
  - B. Cut and clip method
  - C. Paragraph method
  - D. Guide specifications

- IV. Specifications of Materials and Processes
  - A. Dimensions
    - 1. Not drawing dimensions
    - 2. Material dimensions
  - B. Quality
    - 1. Type of material
    - 2. Grade of material
  - C. Finish

ESTIMATING - SCHEDULING

Reading Assignment
Day 35

- I. Introduction
  - A. Estimating
  - B. Scheduling

- II. Estimating
  - A. Preliminary estimates
    - 1. Through client interest
    - 2. Schematic stage - volume and area estimates
    - 3. Must be reasonably accurate
    - 4. Architectural area
    - 5. Architectural volume

Reading Assignment
Day 35 (continued)

- B. Unit costs
    - 1. Variations affecting unit costs
        - a. Design and construction
        - b. Location
        - c. Time of construction
        - d. Miscellaneous
    - 2. Similar units cost about the same
        - a. Building type
        - b. Material classification
- C. Early cost approximation
    - 1. Assumed cost per occupancy unit
        - a. Hospital bed
        - b. School rooms
    - 2. Volume and area figures
- D. Semidetailed estimates
    - 1. Employed when doing
        - a. Remodeling job
        - b. Structure unique in design
    - 2. Detailed element cost analysis (in place unit cost method)
- E. Quantity survey and unit cost estimating
    - 1. Labor cost estimated
    - 2. Each material estimated by cost per unit of material

III. Scheduling

- A. Types
    - 1. Critical path method
    - 2. Bar chart
- B. Progress chart
    - 1. Shows times alloted for each section of the job
    - 2. Show parts to be completed before others can be started

INTRODUCTION TO ORGANIZING

Reading Assignment
Day 36

- I. Introduction
    - A. All activities are organized
        - 1. Family chores
        - 2. School classes
        - 3. Small business
        - 4. Corporations
    - B. Organizing occurs in all industries
        - 1. Farming
        - 2. Manufacturing
        - 3. Construction
- II. Organizational Practices
    - A. Structuring the organization
    - B. Supplying resources

STRUCTURING THE ORGANIZATION

Reading Assignment
Day 37

- I. Introduction
    - A. Organizing manpower
        - 1. Work assignment
        - 2. Establish hierarchy
    - B. Practices of structuring
        - 1. Analyzing work tasks
        - 2. Determining worker functions
        - 3. Establishing roles
        - 4. Setting work conditions
- II. Analyzing Work Tasks
    - A. Know requirements for completing a construction job
        - 1. Mental requirements
        - 2. Physical requirements
    - B. Determining individual tasks
        - 1. Sequence system
        - 2. Trade assignments

Reading Assignment
Day 37 (continued)

- III. Determining Worker Functions
  - A. Know each job
  - B. Select his actions to handle job

- IV. Establishing Roles
  - A. Knowing men
    - 1. Experience
    - 2. Competance
  - B. Selecting managers
    - 1. Responsible for their own work
    - 2. Responsible for other mens' work

- V. Setting Work Conditions
  - A. Proper working methods
  - B. Safety precautions

SUPPLYING RESOURCES

Reading Assignment
Day 38

- I. Introduction
  - A. Supplying men
  - B. Supplying materials

- II. Requisitioning
  - A. Men
    - 1. Management
    - 2. Contractors
  - B. Materials

- III. Procuring and Subcontracting
  - A. Materials
  - B. Men and materials

- IV. Routing
  - A. Providing for
  - B. Timing
    - 1. Protecting materials
    - 2. Site arrival

Reading Assignment
Day 38 (continued)

V. Storing
   A. Planning the site
   B. Equipment
   C. Materials
      1. Sequence
      2. Protection

INTRODUCTION TO CONTROLLING

Reading Assignment
Day 41

I. Introduction

II. Assumes proper execution of project
   A. Cuts down on poor workmanship
   B. Assumes use of specified materials
   C. Maintains quality workmanship
   D. Cuts down on loss of money and time
   E. Provides feedback to designer and owner of progress
   F. Corrects errors made as fast as possible

III. Phases of Controlling
   A. Directing
   B. Monitoring
   C. Reporting
   D. Correcting

DIRECTING

Reading Assignment
Day 42

- I. Introduction
    - A. Give directions that will obtain desired results
        - 1. Issue good instructions
        - 2. Follow up instructions
        - 3. Use standard practices and indoctrination to simplify directing
        - 4. Explain why, to ensure understanding
        - 5. Use consultative direction in key relationships
    - B. The directing positions are
        - 1. Supervising
        - 2. Coordinating

- II. Supervising
    - A. Takes place in planning, organizing and production
    - B. Overseeing activity

- III. Coordinating
    - A. Promote coordination in all phases of administration
        - 1. Harmonize programs and policies
            - a. Check for consistency
            - b. Synchronization
        - 2. Organize for coordinated action
            - a. Group closely related activities
            - b. Make organization and procedures clear-cut
        - 3. Design effective means of communication
        - 4. Aid voluntary coordination
            - a. Install dominant objectives
            - b. Develop customs and terms
            - c. Encourage informal contacts
            - d. Provide liaison men where needed
            - e. Use committees

MONITORING

Reading Assignment
Day 43

- I. Introduction

- II. Inspecting

Reading Assignment
Day 43 (continued)

- A. General feature inspecting
  - 1. Observing personnel actions
  - 2. Listening for unfamiliar work sounds
- B. Dimension inspecting
  - 1. Gaging
  - 2. Comparing
  - 3. Measuring
- C. Soundness inspecting
  - 1. Sectioning
  - 2. Non-destructive testing
- D. Chemical and metallurgical inspecting

III. Inventorying
- A. Continual process
- B. Quantity of materials
- C. Quality of materials

IV. Timekeeping
- A. Keeping track of work time
- B. Kinds of timekeeping
  - 1. Timeclock
  - 2. A timekeeper
  - 3. Men paid by the job, rather than the hour

REPORTING

Reading Assignment
Day 45

I. Introduction
- A. Next step in controlling phase
- B. The steps in reporting are:
  - 1. Compiling
  - 2. Appraising
  - 3. Notifying

II. Compiling
- A. Upon completion of the inspecting phase
- B. Gathering and collecting information

III. Appraising

IV. Notifying

CORRECTING

Reading Assignment
Day 46

- I. Introduction
    - A. Lack of perfection
    - B. Short cuts
    - C. Methods of Correcting
        - 1. Adjusting
        - 2. Expediting
        - 3. Restraining
        - 4. Replanning
        - 5. Redirecting
        - 6. Retraining

- II. Adjusting
    - A. Poor alignment
    - B. Men must adjust
    - C. Definition

- III. Expediting
    - A. Work activity
    - B. Men
    - C. Definition

- IV. Restraining
    - A. Definition
    - B. Activity
    - C. Men

- V. Replanning
    - A. Offense to defense
    - B. Revisions

- VI. Redirecting
    - A. Change in policy
    - B. Stricter supervision
    - C. Better coordinating

- VII. Retraining
    - A. Change in original process
    - B. Advancement in technique

UNIT III

PRODUCTION IN CONSTRUCTION

CHANGING THE FORM OF MATERIALS

Reading Assignment
Day 53

- I. Shaping the Environment
  - A. Functions of structure (purposes)
    - 1. Shelters - buildings, houses, garages
    - 2. Accesses - roads
    - 3. Span distance - bridges
    - 4. Retaining - dams
    - 5. Elevate - towers
    - 6. Penetration - tunnels
    - 7. Utility - reservoirs, sanitary plants, powerlines
  - B. Major phases of on-site construction
    - 1. Preparing the site
    - 2. Building the structure
    - 3. Completing the site
  - C. Post Processing
    - 1. Repairing
    - 2. Altering
    - 3. Installing
    - 4. Maintaining

- II. Worker Control Over Materials
  - A. Measuring
    - 1. Laying out
    - 2. Marking
  - B. Positioning
    - 1. Aligning
    - 2. Adjusting

- III. Practices of Material Handling
  - A. Protecting
  - B. Generating
  - C. Fluidized transport of solids
  - D. Flow transport of solids and liquids
  - E. Loading
  - F. Unloading
  - G. Attaching
  - H. Carrying
  - I. Hoisting
  - J. Lowering
  - K. Releasing

Reading Assignment
Day 53 (continued)

- IV. Practices of Material Separating
  - A. Classifying
  - B. Material Removing
- V. Practices of Combining Materials
  - A. Mixing
  - B. Coating
  - C. Assembling
- VI. Practices of Forming Materials
  - A. Working
  - B. Displacing
  - C. Thermal Conditioning

PREPARING THE SITE

Reading Assignment
Day 54

- I. The Need For Preparing a Site
  - A. Kinds of sites
    - 1. Rural - restricted, unrestricted
    - 2. Urban - restricted, unrestricted
    - 3. Suburban - restricted, unrestricted
  - B. The earth as a material to be shaped
    - 1. Types of soil
      - a. Compacted earth
      - b. Rock
      - c. Marsh
    - 2. Topography
      - a. Flat
      - b. Sloping
      - c. Rugged
      - d. Plant covered
- II. Stages in Preparing a Site
  - A. Setting up temporary facilities
  - B. Clearing the site
  - C. Surveying for construction
  - E. Earthworking

SETTING UP TEMPORARY FACILITIES

Reading Assignment
Day 55

- **I. The purpose of providing temporary facilities is to provide:**
  - **A. accesses for men and equipment**
  - **B. privacy and protection for men and equipment**
- **II. Problems in setting up temporary facilities are:**
  - **A. gaining water and power**
  - **B. overcoming difficult access**

PROVIDING TEMPORARY ACCESS AND PROTECTION

Reading Assignment
Day 56

- **I. Accesses for Men, Materials, and Equipment Are Needed**
  - **A. Accesses must be adequate to handle the traffic assigned to them, e.g., heavy trucks and equipment.**
  - **B. Adjoining land, whether structure or land, must be protected against damage and collapse.**
  - **C. Materials and equipment must be protected against theft.**
  - **D. Non-construction personnel and construction personnel must be protected against accident, either on or near the site.**
  - **E. Accesses to and on the site must be provided which may involve the building of roads and/or pathways.**
  - **F. Every site must have access protection.**
  - **G. Restricted sites may pose special problems with regard to the provision of access.**
- **II. Protecting Personnel and Property**
  - **A. The contractor has a responsibility for the safety of both construction personnel and general public, as well as adjoining property and site materials.**
    - **1. The contractor is responsible for the safety of his men and of the public.**
    - **2. The contractor is responsible for the protection of adjoining property against damage or collapse.**
    - **3. The contractor is responsible for the protection of the site and contents against loss by theft.**

B. Posting is the erection of signs and notices against damages from construction operations.
  1. These signs should be posted in advance.
  2. They should be easy to read, and in a position which would attract attention.

C. Fencing is the erection of a barrier or obstacle in order to prevent access.
  1. Fences should be sturdy enough to last for the duration of the construction project.
  2. Fences should be of sufficient height to prevent trespassing.
  3. Fences may be built of timber, wire and post, sheeting, and many other materials.

D. Banking is heaping earth or other material to discourage passage through, or across, the site.
  1. Banking is rarely used solely for the protection of property or personnel.
  2. Such protection is incidental to the stockpiling of some material, or to grading, or other earthmoving operations.
  3. Bulldozers, backhoes, draglines, etc. may be used.

E. Ditching is digging a trench or ditch to prevent passage across or through the site.
  1. Trenches or ditches are rarely dug for the sole purpose of protecting personnel and/or property.
  2. They usually form part of a temporary site drainage system for the control of ground water.
  3. The ditch itself, especially if it is deep, should be sign-posted.
  4. Ditches act as barriers, usually only in a secondary manner.
  5. Excavators, backhoes, trenchers, clamshells, etc., or hand-digging tools (shovels, picks, etc.) may be used.

F. Bracing and Shoring prevent collapse by transmitting or diverting pressure or weight.
  1. Adjoining property, depending upon its condition and structural design, may need to be shored or braced to prevent collapse or damage.
  2. Props or supports placed diagonally to, against, or underneath something prevent sagging or collapse.
  3. There are many methods of shoring and bracing--horizontal, vertical, diagonal.
  4. Materials used are timber or steel.

G. Weatherproofing is treating surfaces to prevent the passage of moisture to the interior of an adjoining structure.
  1. Parts of adjoining structures which have been exposed by construction work on the site must be protected against the weather.
  2. This is usually accomplished by applying a thin membrane or skin to the exposed surface, or coating the surface with a waterproof material.

3. Materials used include asphalt, waterproof paper, and cement rendering.

III. Laying Roads and Walkways
  A. Roads and walkways are necessary for the movement of men and materials.
    1. Any site may pose special problems of access, e.g., overcoming physical obstacles, or location remoteness.
    2. The practices involved in laying roads include: grading, bridging, compacting, surfacing, and rolling.
  B. Grading is leveling the earth's surface.
    1. Some grading is always necessary.
    2. An attempt is made to balance the amount of earth cut away with the amount which must be filled in.
    3. Bulldozers, draglines, scrapers, spreaders, and manpower are used in grading operations.
  C. Bridging is building an access route to join together two otherwise inaccessible points.
    1. Bridging is often expensive, so the need for a bridge should balance the cost of providing it.
    2. Temporary bridges are often built of prefabricated units of metal or timber.
    3. Cranes, hoists, and jacks are often used in the construction of temporary bridges.
  D. Compacting is consolidating the soil particles to prevent settlement, thus provising a stable base for roads and walkways.
    1. Soils disturbed by earthmoving operations need to be compacted, because if this is not done, settling earth may cause damage to the surface or structure overlaying it.
    2. Compressed air tampers, "sheepsfoot" rollers, and smooth rollers are used in compacting.
  E. Surfacing is coating or otherwise covering a base material.
    1. Surfacing may not always be necessary.
    2. The type of traffic may dictate the kind of surfacing used.
    3. Road or walkway surfaces may require periodic maintenance.
    4. Some materials used are: concrete, blacktopping, loose gravel, etc.
    5. Rollers, dumptrucks, and concrete layers are typical of equipment used.
  F. Rolling is the smoothing and compressing of the road or walkway surface coating.
    1. Only some types of surfacing materials need to be rolled.
    2. Machine or hand rollers are used.

ESTABLISHING TEMPORARY SHELTERS

Reading Assignment
Day 57

I. Workers, Equipment, and Materials Need Shelter From the Weather
    A. Shelters for workers include work offices, tents, and sanitary facilities.
    B. Materials must be protected against frost, rain, snow, heat, wind, and in some cases, excessive sunlight.
    C. Shelters should be designed for easy removal, and arranged on the site to cause the least interference with construction.
    D. Shelters may be hauled or towed to the site.
        1. Some shelters may be prefabricated, and brought in as components, or as an entire assembly.
        2. Trailers housing some contractors' equipment and tools are brought to the site and positioned.
    E. Temporary shelters are set up by parking or fabricating them on the site.
        1. Trailers are usually jacked up and blocked.
        2. A temporary base is usually provided to support the shelter.
        3. Shelters will be on site for the duration of construction.

PROVIDING TEMPORARY UTILITIES

Reading Assignment
Day 58

I. Water and Power Are Necessary Before Work Can Begin
    A. Water is needed for cleaning, mixing, and sanitary purposes at a construction site.
    B. Electricity is needed for power equipment, lighting temporary offices, warning lights, heating, and night lighting to permit work to proceed.
    C. Water and power are usually obtained from existing service lines.
    D. If no service lines exist, the contractor must provide his own utilities.

II. Water is Needed in Construction For Mixing, Washing, Misting, Pumping, Sanitation and Human Consumption
    A. Water service is provided by connecting and plumbing it onto the site.
        1. Connecting is hooking up to existing water lines.
        2. A hole may need to be dug to make the connection.
        3. Plumbing is distributing the water by pipes to points of use.
        4. Pipes are usually laid in trenches.
        5. Plumbing materials usually are cast iron, earthenware, plastic.

Reading Assignment
Day 58

B. When water service is not available, it may be necessary to drill a well, or provide a water storage tank.
    1. Welling is the process of tapping water bearing geological formations (ground water), and pumping or drawing it to the surface.
    2. Sometimes several wells may be required.
    3. Equipment may include drill rigs and hand tools.
    4. Water may be stored in tanks, which are usually elevated to permit water to flow to points of use by gravity.
    5. Storage tanks usually hold thousands of gallons of water.

III. Power is Provided By Connecting, Wiring, And Generating
  A. Power may be needed for electricity, compressing fluids or air, or pumping materials.
    1. Connecting is the hooking up to existing service lines by additional wiring.
    2. Wiring is the distribution of power to points of use on site.
    3. Generating is the production of electrical or mechanical power independent of existing power supplies.
    4. Typical equipment using power are drills, power saws, pumps, compressors.

CLEARING THE SITE

Reading Assignment
Day 59

I. The Site is Cleared of Obstacles to Provide a Suitable Working Area and Safe Working Conditions
  A. Clearing the site involves the reduction of obstacles and the handling of materials.
  B. Obstacles may include old, or unused, or unwanted structures, brush, trees or forest, rock, unfavorable terrain (contours, etc.), streams which interfere with construction plans.
  C. Most sites need some form of clearing.

REDUCING OBSTACLES

Reading Assignment
Day 60

I. Obstacles are reduced from their natural or man-made size or state to a size suitable for handling
  A. Not every obstacle can be handled in its natural form.
  B. Various means of reducing obstacles are used.
  C. Reducing obstacles may involve demolition and/or salvaging, extracting the loose reduced material, and transferring and disposing of it.
  D. For example, trees or rock outcroppings need to be reduced in size before they can be removed.

II. Demolishing and Salvaging
  A. Demolishing is the tearing down and destruction of obstacles, while Salvaging is the saving of materials resulting from demolishing.
    1. Ways of demolishing include wrecking (structures), bulldozing (brush, small trees, light structures, small earthmounds), cutting (trees, brush), chaining (trees), blasting (rock or heavy man-made structures), and burning (brush and debris).
    2. Parts of structures or obstacles are salvaged by careful disassembling or uprooting.
  B. Disassembling is unfastening or disconnecting previously-assembled components.
    1. Some materials obtained from the reducing of obstacles have a value and may be reused.
    2. The nature of certain obstacles and the siting of certain obstacles may dictate that they be disassembled rather than demolished.
    3. Some obstacles may be reduced with greater safety by disassembly.
    4. The materials or components disassembled need to be cleaned and stored, or disposed of in some manner.
    5. Disassembly requires considerable skill and care on the parts of the workers.
  C. Wrecking is the destruction of an obstacle by swinging against or dropping a great weight, or otherwise destroying by force.
    1. Wrecking is a rapid way of demolishing or reducing an obstacle.
    2. Wrecking reduces obstacles to rubble.
    3. When wrecking is used, little or nothing can be salvaged.
    4. Wrecking may be dangerous if proper precautions are not taken to insure the safety of personnel and adjoining properties.
    5. Equipment used may be ball and chain rigs, and shovels.

D. Bulldozing is the pushing over or uprooting of obstacles by force.
  1. Horizontal force may be applied to light obstacles.
  2. Different types of blades are used for different jobs.
  3. The bulldozer clears a path the width of its blade.
  4. Equipment used are tractors equipped with blades.

E. Cutting is the dividing of units into smaller parts for easier handling.
  1. Cutting can be done with a bulldozer, saw, axe, torch.
  2. Trees, old timber, steel structures, stumps are among the obstacles which might be cut.

F. Chaining is dragging down stands of timber by means of a cable attached to a driving force.
  1. The pulling or dragging action of the tractors is transferred to the trees by the chain.
  2. Chaining breaks trees loose from the earth.
  3. A large weight (ball) attached to the chain keeps it raised above the ground.
  4. Chaining equipment includes two tractors, chain and a ball weight.

G. Blasting is separating by explosion for the purpose of leveling or removing obstacles.
  1. Blasting is used to demolish or loosen large quantities of rock or hard, compacted soils to facilitate handling.
  2. Blasting equipment includes dynamite or nitroglycerine, a generating box and wire.
  3. It is usually necessary to penetrate the material to be blasted by drilling holes.
  4. Blasting requires strict safety precautions.

H. Burning is used to rid the site of debris, and to reduce obstacles.
  1. Burning debris on the site must be controlled.
  2. Debris may be burned in an open fire or in an incinerator.
  3. Materials commonly burned are old timbers, twigs, branches, chips, or other rubbish accumulated in the clearing process.
  4. Structures may be demolished by burning when no salvage value exists.
  5. In all cases, precautions must be taken to protect nearby property.

III. Extracting

A. Extracting is the dislocation of an obstacle from its bed.
  1. Obstacles are extracted when they are of a size or consistency suitable for handling.
  2. Extracting includes the rerouting of rivers or streams, digging soil or earth, scraping surface materials, ripping soil, grubbing out tree roots and draining water or semi-liquid materials.

B. Draining is the removal of water or semi-solids by the use of gravity or by pumping or suction forces.
   1. If ground waters are present, draining is necessary so that the contractor may have a dry working surface.
   2. Excessive water (if not controlled or drained off) may cause the structure to "float" or be uplifted.
   3. Dredging is a form of draining whereby semi-solids are removed from river or stream beds by suction pumps and deposited elsewhere.

C. Rerouting is changing the course of a river, stream, or public utility to gain access or to clear the construction area.
   1. It may be necessary to redirect the course of a river or stream, or to provide alternate public facilities (road, path, bridge) so that construction can proceed.
   2. Rerouting may involve ditching, draining, or tunneling to provide the alternate course--for example, to change the course of a river to gain access to a dam site.
   3. Rerouting can be very expensive and, at times, difficult.

D. Digging is the removal of geological elements or debris from around an obstacle for the purpose of loosening or removing it.
   1. Digging may be done by hand or by mechanical shovels.
   2. An obstacle is dug out when blasting or burning is impractical.
   3. Digging in this context is a comparatively small operation.

E. Ripping is deep raking for the purpose of breaking up compacted soil.
   1. A ripping machine may tear the surface to a depth of two feet.
   2. Ripping is used as an alternative to blasting for loosening compacted soils and soft rock.

F. Scraping is the removal of surface soil in thin layers.
   1. Most large jobs make use of scrapers, particularly highway and reservoir projects.
   2. Surface soils scraped have a value and are usually reused, either on the site, or elsewhere.
   3. Earth, sand, gravel, clays, silts and some shale can be removed by scraping.
   4. The sequence of scraping is:
      a. Scraping and loading
      b. Hauling
      c. Unloading and/or spreading
      d. Return

G. Grubbing is the removal of root systems incidental to surface growth.
   1. The type of root dictates the method of grubbing.
   2. Common methods of grubbing are tractors equipped with stump pullers or bulldozers with small blades for pushing the stumps out.

HANDLING MATERIALS

Reading Assignment
Day 61

I. Materials resulting from demolishing, salvaging, or extracting operations must be moved from one place to another either on or off the site.
    A. The material must be grasped or attached and loaded on or in the handling device.
    B. The material must be transferred, unloaded or released, or otherwise deposited on or off the site.

II. Transferring Materials
    A. Transferring is the movement of materials from one place to another.
        1. Transferring involves loading and hauling debris, stumps, trees or logs, rock, soil, pushing soil or rock, dragging logs or stumps or debris, pumping liquids or semi-solids.
        2. The type of material to be transferred and the type of equipment available will dictate the method of transferring.
        3. The location and character of the site will influence the method of transferring.
        4. Large quantities of materials are involved in this process.
    B. Loading and Hauling is placing material in or on a self-propelled or towed vehicle and removing it from the site.
        1. The excavating equipment may be capable of loading the material.
        2. Hauling is usually done by trucks.
        3. Large quantities of material, spoil or debris are involved.
    C. Dragging is the attachment of the material or obstacle to a powered unit by means of a cable and pulling it away.
        1. Some materials or obstacles cannot be conveniently loaded and hauled away, thus dragging is an alternate method.
        2. Examples of such materials are tree stumps, logs, old steel members, large rocks, etc.
        3. A tractor is commonly used in such operations.
    D. Pushing is the act of force applied behind the material to be transferred.
        1. Tractors or bulldozers are commonly used to push such material as logs, debris, or rock from the working area.
    E. Pumping is the transfer of liquids or semi-liquids through a pipe or ditch system by means of pressure.
        1. Depending upon the origin and nature of the material, pumping may have to be continuous throughout the construction process.
        2. Pipes or ditches are built to carry or transfer the material by gravity.

Reading Assignment
Day 61 (continued)

III. Disposing of Materials On-Site
  A. To rid the working area of debris or salvaged material, the material is stockpiled, burned, or buried on the site.
    1. Materials must be stockpiled or disposed of in a location where they will not interrupt the work.
    2. Materials may be stockpiled for future use.
    3. Some materials are worth saving for potential future use, e.g., earth for backfill, top soil for sodding, etc.
    4. Other materials have no real value and can be destroyed or buried on or off site as specified or desired.
  B. Stockpiling is the storing or stacking of material on site for future use.
    1. Cut logs, timber, or top soil may be reused for landscaping.
    2. Materials are stockpiled where they will be out of the way, but readily available.
  C. Burying is the covering up of materials that have no reuse value.
    1. A bulldozer is commonly used in burying operations.
    2. Debris or other useless materials are sometimes used to assist in leveling the site.
  D. Burning is destroying by fire.
    1. Burning can be a cheap method of disposing of useless materials.
    2. Because of danger of fire to adjoining structures or equipment, burning operations must be carefully supervised and controlled.
    3. Burning may be in an open fire, a pit, or a furnace.
  E. Spreading is the distribution of thin layers of soil.
    1. Soil may be spread over large areas, to eliminate large mounds.
    2. Spreading may be part of the grading operation.

SURVEYING FOR CONSTRUCTION

Reading Assignment
Day 62

I. Surveying is the use of measurement to locate and fix points so as to outline the structure in its proper relationship to its surroundings.
  A. Surveying includes referencing and laying out the structure.
    1. Surveying is necessary before any kind of construction can begin.
    2. Surveying is the art of measuring horizontal and vertical distances between terrestrial objects, of measuring angles between terrestrial lines, of determining the direction of lines, and of establishing points by predetermined angular and linear measurements.

3. Extreme accuracy is required in all surveying.
4. Examples of surveying are: establishing highway center lines, and right of way width, locating and determining elevations of sewers, pipelines, canals, bridges, tunnels, etc.

II. Referencing to Existing Features
  A. In order to establish and maintain the proper location of the future structure on the site and in relation to its surroundings, points are selected and their position recorded to be used later in laying out the structure.
    1. The layout of the future structure must be related to known points.
    2. These reference points--which locate transit stations, etc.--must be clearly marked, and their position recorded.
    3. Instruments used include: transit, tape (steel, linen), rod, etc.
  B. Measuring is the locating or fixing of points by reading dimensions, elevations, and angles by use of a transit and/or tape. These locations are recorded for future use in laying out the structure.
    1. When a corner of a building or other structure has been located with reference to known points, the distances between are read off either by transit and tape, or tape alone.
    2. Recording is the writing down of measurements taken during the reading , for later reference should the points of measurement become obliterated.
  C. Common methods of Marking reference points are staking, tagging, painting.

III. Laying Out the Structure
  A. The outline of the structure is marked on the site by means of offset or building lines and control points.
    1. Control points are set up by reading angles and measuring distances between points so as to check the accuracy of the work and to enable a check (or watch) upon the settlement of the new structure.
    2. These control points must be marked.
  B. Offset lines are established from the control points. Offset lines are simply strings or wires extended between stakes and set at a known distance from the actual structural location (hence: offset). The purpose of offsetting these lines is to prevent their being disturbed in the course of the work.
    1. The offset lines are usually marked with flags or tags after being strung between measured points.
    2. Offset lines may need to be leveled.
    3. Offset lines and stakes need to be protected against dislocation.

EARTHWORKING

Reading Assignment
Day 63

I. Earthworking is the rearrangement of geological elements so as to provide for the founding of the structure.
    A. Earthworking includes mobilizing equipment, earthmoving, the protection of existing utilities and structures and the shaping and stabilizing of earthworks.
    B. Earth must be worked to provide a firm base for the structure.
    C. Earth must be worked to attain predetermined elevations which do not comply with natural terrain.
    D. Earth may be worked to eliminate hazardous conditions.
    E. Soils easy to work with are sand, clay, and light gravel; soils difficult to work with are rock and compacted soils which are rigid, hard and heavy.
    F. Some earthworking problems are: reaching a strata of sufficient strength to support the structure, overcoming terrain inconsistencies, stabilizing earthworks, and protecting existing structures.
    G. Equipment used are shovels, draglines, backhoes, scrapers, etc.

MOBILIZING EQUIPMENT

Reading Assignment
Day 64

I. Equipment peculiar to earthworking or excavating must be brought to the construction site and set up and positioned for use.
    A. The type of soil will dictate the kind of equipment needed.
    B. The type of equipment the contractor owns may dictate how a site would be excavated.
    C. The sequence of earthworking procedures varies with the site conditions.
    D. Some equipment comes to the site in parts and needs to be assembled on site.
    E. Common types of earthworking equipment include: dragline shovels, power shovels, tractors, rigs, bulldozers, dredges.

II. Transporting
    A. Transporting is moving something from one place to another. This may be accomplished by driving, hauling, or towing.
        1. Some equipment can be driven to the site, depending upon the speed at which the vehicle can travel, the location of the site with respect to access, the types of wheels on the vehicle.

Reading Assignment
Day 64

2. Equipment may be hauled or towed to the site. Some equipment, though self-propelled, may not be suitable for travel on public roads and must be hauled to the site. When hauling large pieces of equipment, consideration must be given to their heights on the carrier, with respect to the overpasses or tunnels through which they must pass.
3. Length and width are also important considerations for bridge crossings, turning radii, and maneuvering onto the site.

III. Setting-Up Equipment
  A. When equipment arrives on the site, it must be unloaded and made ready for use.
    1. Because of the size of the equipment involved, care must be taken in choosing an unloading area which provides ample space for maneuvering. Ramps may be needed for unloading special equipment.
    2. Some equipment has an optimal or best operating position, depending upon the characteristics of the equipment, e.g., the depth of swing radius of a shovel arm. Depending upon the nature of the excavation layout, machines may be positioned for a frontal approach or a "ramping in" approach.
    3. Assembling is fastening together the components or parts of equipment. Some equipment, such as cranes and derricks, must be assembled on site.
    4. Most equipment is serviced, that is, lubricated, adjusted, repaired, and cleaned, before being place in operation.

EARTHMOVING

Reading Assignment
Day 65

I. Earthmoving refers to the rearranging of geological elements for the purpose of providing the bed for the future foundation.
  A. Geological elements vary in their density and rigidity.
  B. Geological elements need to be rearranged or removed to provide foundation beds, e. g., basements, accesses, alterations in grade.
  C. The nature of the geological element dictates the type of equipment to be used, and the method of removal.
  D. The materials are moved in accordance with the previously determined layout.
  E. Many of the processes and practices in this context are similar to those used in clearing the site.

Reading Assignment
Day 65 (continued)

II. Loosening
   A. Many geological elements must be loosened from the earth before they can be removed. The density of the element determines the means of loosening.
   B. Blasting is separating by explosion, usually rock or other hard compacted materials.
      1. Blasting not only removes earth, but loosens the surrounding soil for easier removal.
      2. Blasting reduces the element sizes and facilitates easier handling.
      3. Where the charge is placed, and its strength, determines the amount of earth to be loosened.
      4. Equipment used in blasting includes a blasting machine, dynamite, fuses, blasting caps, and wire.
   C. Breaking means separating by concussion, stress, or strain suddenly and violently. Spalling means to chip or fragment or crumble by forceful blows.
      1. Jackhammers are used to loosen and separate rock or compacted soil.
      2. Holes are spalled (drilled) in rock for dynamiting.
      3. Breaking and spalling are used to separate elements where larger equipment may be inaccessible.
   D. Scarifying means to scratch, stir, or pulverize soil surface. Ripping means to separate by tearing, to the depth of two feet.
      1. Scarifying is used in bulk wide-area excavating to loosen top strata for pickup by scrapers.
      2. Scarifiers and Rippers are mounted or towed at the rear of a tractor, and are usually hydraulically operated.
      3. Ripping replaces blasting as a means of loosening compacted soil, or soft rock.

III. Extracting
   A. Extracting is the displacement or removal of geological elements.
      1. Some soils can be removed in large pieces by digging.
      2. Other soils contain much water and need to be dredged or drained.
      3. Rock soils, after being loosened, must be gathered and removed.
   B. Digging means to excavate, to turn up, or delve into the earth.
      1. The scope or size of the job determines the type of equipment to be used.
      2. The type of element determines the type of equipment to be used.
      3. Typical equipment used are draglines, backhoes, clamshells, moles, trenchers, slackline cables, etc.

C. Scraping means to draw roughly over earth with a sharp or rough blade.
   1. Scraping is done to remove a thin layer of soil over a large area.
   2. Some soils can be scraped without previous loosening; other soils must be scarified first, or otherwise loosened.

D. De-watering is the displacement of fluids or semi-solids.
   1. In dredging, soils are transported by means of water.
   2. Water must be kept out of the excavation. Common means of de-watering are pumping it out, or draining it off by gravity.
   3. Common equipment for de-watering are suction pumps, and ditchers.

IV. Transferring

A. Spoil or loose material must be taken from the excavation, transferred to some predetermined location either on or off the site, and then placed or dumped as specified.
   1. The type of excavation spoil determines the method of handling.
   2. Excavation spoil may be re-used in construction for many purposes.
   3. Excavation spoil may be kept on site,or dumped, or sold elsewhere.
   4. The task of removing tons of earth from damsites or depositing earth for roadbeds requires months of continuous operation and heavy-duty equipment.

B. Loading and Hauling is accomplished by depositing spoil in or on a carrier. Typical equipment includes trucks, scrapers, conveyors,

C. Some spoil may be pushed out of the way when disposal areas are remote. Bulldozers continually push and rearrange earth.

D. Pumping is a normal means of transferring water from the excavation, which allows work to continue. Rains cause excavation problems such as the weakening and collapse of walls, the filling of holes, and bogging down of equipment in mud.

E. Some materials, such as loose gravel, dirt, rock may be continuously transferred by belt conveyors.

V. Disposing

A. Excavation spoil must be disposed of either on or off the site.

B. Materials may be stockpiled for later use as fill.

C. Materials may be deposited by stacking or spreading.

PROTECTING EXISTING UTILITIES AND STRUCTURES

Reading Assignment
Day 66

I. Utilities and Structures must be barricaded from damage. Sometimes nearby structures become weakened by the site excavation.
   A. Excavations may be deeper in the earth than the foundations of adjacent structures, thus weakening the stability of such structures.
   B. Utilities may be uncovered in the process of excavating, and thus need to be protected against the interruption of their services.

II. Rerouting
   A. Rerouting means to change the course of existing utilities (gas, water, electrical wiring, sewer lines) and provide protection for them.

III. Bracing and Shoring
   A. When a building is removed from between existing structures, they may need to be braced to prevent their collapsing.
   B. Bracing provides horizontal force and replaces the stabilizing effect of the removed structure.
   C. Shoring provides angular force for support.

IV. Underpinning
   A. Underpinning gives reinforcement to existing structures when it is necessary to undermine the existing structure's foundation to keep it from collapsing.
   B. Underpinnings are made by digging out sections of earth under the adjacent structure and replacing it with concrete. This, in effect, provides an additional, deeper, base support for the adjacent structure.

SHAPING AND STABILIZING EARTHWORKS

Reading Assignment
Day 67

I. The major excavation may leave a trench or hole in a crude state. Before the foundation can be placed, the walls and bed of the excavation need to be trimmed and stabilized.
   A. The process of shaping foundation beds and walls may be done by hand or machine and may include cleaning, grading, sloping and treating.

B. The process of stabilizing earthworks may include compacting, sheathing, bracing and shoring, piling, and cofferdamming.

II. Cleaning and Washing

A. Mud must be removed from base rock to allow a good bond with concrete. The situation dictates whether washing is necessary. When it is, high-pressure water hosing is used.

III. Grading

A. Grading usually consists of cutting and filling. It may include compacting, grouting, scaling and filling.

1. Compacting is the compressing of earth to make it firm. Rolling compresses the earth and makes a smoother, finished foundation bed. Small areas may be compacted by using an air hammer.
2. Grouting is the filling in of cavities in earth or rock with mortar to provide stability for the foundation walls or bed. Grouting is composed of a cement and sand mixture which may be pumped into the void, or applied by hand.
3. Scaling means to strip or peel layers or large pieces of soil. Usually foundation walls need to be trimmed by scaling, to keep loosened materials from falling onto the excavation bed. Scaling helps give final shape to the walls of the excavation, similar to grading the foundation bed.
4. Filling is the process of building up depressions in the earthworks.

IV. Sloping

A. The sides of excavations may be sloped to reduce the potential for slides or slumps.

1. In large area excavations, sloping is a common method of stabilizing the foundation walls.
2. The surrounding conditions dictate whether sloping can be used.

V. Sheathing

A. Sheathing is the process of walling for keeping earth out of the excavated area.

1. All sheathing requires some type of framework.

2. Common sheathing materials are metal panels, wood planks, or wood panels placed horizontally or vertically and supported by stakes or battens.

Reading Assignment
Day 67 (continued)

VI. Bracing and Shoring

A. Bracing and shoring may include wood or steel panels placed against the earth, between which the brace is placed, or against which the shore is placed, thus keeping the walls from collapsing.

VII. Treating

A. Soils may be treated by impregnating a solidifying substance into the earth to stabilize it.

1. Freezing may be used when soils are thoroughly saturated with water and do not lend themselves to dewatering.
2. Freezing serves two purposes:
    a. it helps to stabilize the soil, preventing collapse
    b. it assists in the control of ground water.

VIII. Piling

A. Piling is used to provide additional stability for the structure by driving huge, concrete, steel, or wood stakes into the ground.

1. Piling improves the soil-bearing capacity of the earth.
2. Piling is used when the soil is not firm enough to support the structure.
3. Piling aids in guarding against uneven settlement of the structure.
4. Holes are bored into the earth and either filled with concrete or piles are driven into them.
5. An example of piling may be found on a waterfront, where piers are supported by piles which were driven into rock bottom.

IX. Cofferdamming

A. A cofferdam is a chamber which provides a dry working area.

1. Cofferdamming is used to build foundations in water, or excessively water-laden soil.
2. Cofferdamming is similar to driving a large cylinder through water to bedrock, dredging out the muck, pumping out the water, and filling the cavity with concrete.
3. It is necessary to keep the water out of this area permanently to insure proper bonding and curing of the concrete.

BUILDING THE STRUCTURE

Reading Assignment
Day 69

I. A structure is any comformation or assemblage of materials for which the purpose of building is being carried on. Included are: buildings, roads, bridges, dams, tunnels, utilities, and towers.
   A. The functions of structures are to provide: shelter, access, elevation, penetration, retainment, or utility.
   B. The purpose of buildings is to satisfy a human want.
   C. The second major phase of Production in Construction is building the structure. After the site has been prepared, the structure must be built, that is, given a foundation, given strength and stability, given necessary ancillary utilities, and finished.
   D. The major stages of building a structure are: setting foundations, building major structural elements, installing circulatory systems, and, finishing the structure.

II. The building of all structures follows the sequence of setting foundations, building the major structural elements, installing circulatory systems, and finishing the structure. However, the degree of emphasis given to the building practices vary with the structure to be built. For example, much of the task of building a road may be found in preparing the site, that is, clearing the land, and earthworking, to give shape to the road bed. However, the practices, materials, and equipment which make up the foundation and surface are found in building the structure, while landscaping the road area can be found in the third major phase, Completing the Site. Another example is a building. The site may need extensive, or little, preparation and the practices are found in Preparing the Site. The bulk of the work may take place in Building the Structure. A major task may be setting foundations, or, in the case of a skyscraper, building the major structural elements may be given most or equal emphasis eith installing circulatory systems and enclosing and completing the structure. If the skyscraper is in a city, very little landscaping may be needed to complete the site.

III. The following is a small sample listing of kinds of structures that are built. Each may have one or more functions and purposes.
   A. Buildings: skyscrapers, apartments, houses, carports, garages, shopping centers, service stations, banks, libraries, missile storages, airports, train stations, etc.
   B. Towers: television towers, radio, radar, power lines, lighthouses, silos, forest ranger stations, ski lifts, granaries, dirigible stations, water towers, etc.
   C. Tunnels: underwater, underground, tunnels for cars, trains, subways, humans, etc.

Reading Assignment
Day 69 (continued)

D. Dams: banked earth for reservoirs, lakes, concrete dams for generating power and regulating water flow, inflated bag dams, spillways, etc.
E. Roads: superhighways and interchanges, city streets, drives, county roads, paths, etc.
F. Bridges: suspension, girdered, pontoon, etc.
G. Utilities: electrical, water mains, power generating plants, sewage treatment plants, reservoirs

IV. In all cases, the building of any of the foregoing structures follows the sequence, or involves the practices, found in setting foundations, building the major structural elements, installing circulatory systems, and finishing the structure.

SETTING FOUNDATIONS

Reading Assignment
Day 70

I. The purpose for Setting Foundations for any structure is to distribute and transmit the weight and load of the structure to the bearing strata. The activities which relate to setting foundations are: making and placing forms, setting reinforcement, preparing foundation materials, handling foundation materials, bonding, curing, removing forms, and finishing foundations.

II. A foundation is that part of the structure which supports the weight and load of the structure. It may be the footer or pad of a building, the compacted crushed rock layer on a road, or the block of concrete upon which a bridge or tower is supported, the base or footer of a dam. Building foundations are usually thought of as being any part of the substructure, that is, the part below the normal level of the land.

A. Concrete is, by far, the most common foundation material used. Foundations may also be made from block, or rock.
B. Common types of foundations are:
    1. Strip foundations, where the foundation pad is continuous. This type is very common in structures of the bearing type.
    2. Pad foundations are often used in frame structures where each column has its own independent pad.
    3. Raft foundations, i.e., a continuous slab underneath the structure is common where the bearing capacity of the soil is poor.

MAKING AND PLACING FORMS

Reading Assignment
Day 71

I. **In order to give shape to the foundation and hold the foundation material rigid during the curing or hardening process, forms or molds are built, treated, and assembled on the foundation site, or they may be prefabricated elsewhere and brought to the site for assembly. Great care is necessary in making and placing forms to ensure accuracy of the work and to avoid damage to the concrete. Forms are usually made which can be easily removed. Making and Placing Forms is the major operation in setting concrete foundations.**

II. **Building Forms**
   A. **Forms are built of wood, metal, plastic, etc., either on or off the site. Forms materials must be laid out, cut, and assembled. Formwork is a structure in itself, and must be strong enough to resist the weight and impact of the foundation materials, as well as support its own weight.**
   B. **Laying out is the practice of dimensioning and marking off the materials, indicating the shape to be cut.**
      1. **Layout and marking must be accurate.**
      2. **Laying out is done in compliance with plans and specifications.**
      3. **The positions of pipes, ducts, or other elements which will penetrate the foundation are marked carefully on the material.**
      4. **Common tools of layout include squares, tape measures, compasses, and marking tools.**
   C. **When the outlines of the form components have been marked on the material, excess material is removed, or cut away.**
      1. **Accuracy is required in cutting.**
      2. **Formwork materials may be cut by sawing (in the case of wood or metal), or be cut by burning (as a torch cutting heavy metal).**
   D. **After the single form members have been cut, they may be moved directly into position, or be pre-assembled to make a larger component form, and installed as a unit.**
      1. **Pre-assembly makes handling easier.**
      2. **Forms must be handled with care to avoid damage.**

III. **Assembling in Place**
   A. **When formwork components are completed (pre-assembled), they are transferred to the foundation site by hand or machine, positioned, fastened together, stabilized, and adjusted.**
   B. **Accuracy in positioning forms is extremely important for later alignment and ease of fastening. Steps must be taken to avoid damaging the forms. Heavy forms may be handled by cranes.**
   C. **Forms are usually fastened together by pinning (nailing, bolting), or by clamping.**

D. When the forms are positioned and fastened, they must be held in place or stabilized to prevent movement during the placing of the foundation material, and during the curing process.

1. Bracing and shoring is normally used to support and anchor the forms in place.
2. Provision must be made for final adjustment and alignment of the forms before and during the placement to correct inaccuracies.

IV. Treating Forms

A. Forms are treated in different ways, depending upon the type of form material being used, and the design of the formwork. Treating may include cleaning, coating, soaking, or any combination of these. Forms may be treated before or after they are set in position. Forms are treated:

1. to prevent absorption of water from the concrete by the formwork material
2. to facilitate removal
3. to create a texture on the face of the foundation material
4. to remove dirt and debris which might adversely affect the concrete.

B. Forms are cleaned by scraping or washing foreign materials from the forms. Provision should be made in designing the forms for gaining access to the bottom of the forms for cleaning purposes.

C. Certain types of forms--depending upon the material used--need to be coated (either oiled, or greased, or both) to facilitate easy removal and to prevent moisture absorption. Some forms may be shellacked. Care should be taken to remove all excess coating material before the concrete is placed.

D. Some forms may be soaked with water some time before the concrete is placed, so as to prevent absorption and to help tighten joints by swelling.

PREPARING FOUNDATION MATERIALS

Reading Assignment
Day 72

I. When pressure is applied to concrete, it is very strong in resistance. When pulled apart, however, the concrete is weak. Steel reinforcing, which is very strong when pulled, is used to strengthen the concrete and give it resistance to pull. Many foundations do not require reinforcement for additional strength, but in many cases reinforcing is used, and is put in the forms before the concrete is placed.

A. Reinforcement is usually steel, in the form of bars, or welded wire fabric.

B. Reinforcement may need to be cleaned, shaped, and transferred to the forms.

II. Cleaning and Shaping Reinforcement

A. The steel bars or mesh may be cleaned to remove excessive rust, paint, scale, or dirt which reduce its efficiency in imparting strength to the concrete by preventing the proper bond between them.

B. The position, number of bars, or extent of mesh in the concrete will have already been decided. The reinforcement must be cut to size, shaped or bent into the size and form it will be required to hold in the concrete.

1. Reinforcement is shaped to specified lengths and forms before being placed in the forms.
2. Shaped reinforcement is assembled and bound together to take the rough form of the member it is to lend strength to, for example, a beam or column or foundation footing.
3. This shaping or bending can be done on site or in the steel mill (i.e., pre-fabricated).
4. Bars and mesh may be cut with large snips, torch, or saw.
5. Bars usually have serrated or raised "threads" for additional holding strength in the concrete.

III. Transferring and Placing

A. After the reinforcement has been cleaned and shaped, it must be lifted and placed in the formwork in the position in which it will hold the concrete.

1. The position is predetermined.
2. Accuracy is required in placing formwork.

IV. Supporting

A. Like the formwork itself, the reinforcement must have a seat on which to rest, and supports to hold it in its proper position in the formwork.

B. Seats or supports must be provided to hold the steel reinforcement in its proper position with respect to the walls and bed of the formwork. These seats are called bar chairs, or bar spacers. They are designed to ease the job of placing reinforcement.

C. Ties or wires are used to tie, hold, and locate the steel bars or mesh with respect to the walls of the formwork.

V. Preparing Foundation Materials
  A. The material for foundations is made up of a combination of inert materials called aggregates and a paste composed of cement and water. All materials used in foundations or other structural elements must be clean, of first quality, and free from foreign elements.
    1. Concrete is the material most commonly used in foundations.
    2. The cement-water paste, when hardened, binds the aggregates (inert materials) together and fills the voids or empty spaces between the particles.
    3. The water and all other materials used in concrete must be clean: water "fit to drink."
    4. The aggregates must be clean and well-graded.
    5. All materials used are measured.
    6. The materials should be prepared as close to the point of use as possible.
    7. All equipment and tools used in the preparation of concrete must be kept clean.

VI. Treating Materials
  A. It is necessary to treat natural materials to free them from impurities when using them in concrete. It is sometimes necessary to control the temperature of the materials before mixing, so as to avoid excessive build up of temperature within the raw concrete.
    1. Some concrete materials or foundation materials need to be treated.
    2. Treatments may include washing and chilling of the material.
    3. Treatment is usually designed to remove impurities.
    4. The manner in which the foundation material (concrete materials) is stored or stockpiled on site is important. For example, aggregates should be kept damp to prevent excessive segregation (separation of sizes), and stockpiled in layers to protect against contamination by dust, vegetable matter, or other harmful materials.
  B. Natural aggregates used in foundation materials (concrete) should be washed to remove silt, clay or other detrimental materials.
    1. Aggregates may be sand, gravel, or crushed stone.
    2. Natural aggregates called bank-run aggregates are found in a quarry or gravel pit.
    3. These aggregates should be washed before use to remove detrimental materials such as silt or clay which might weaken the bond between the cement paste and the aggregates.
    4. There are also manufactured materials available, such as slag, or cinders, which do not require washing.

C. When concrete foundation material is to be placed in very large quantities (mass), as, for example, in dams or bridge piers, the inert material (aggregates) and the water may be chilled or cooled during the preparation stage. This chilling is done to prevent an excessive build up of heat due to chemical reaction between the materials when the concrete is placed. If heat is allowed to remain unchecked, it may prevent the concrete from setting, or if it does set, subsequent shrinkage may cause cracking of the concrete.

1. Materials are chilled to prevent heat build up.
2. Chilling is usually done only when very large quantities of concrete are being used.
3. Excessive heat build up in the concrete may prevent or delay setting, or when set, cause cracking.
4. On very large projects, a chilling plant is set up--for example, at Hoover Dam, during the construction.

VII. Proportioning and Batching

A. Each of the foundation materials (aggregates, cement, and water) must be classified as to size, moisture content and cleanliness. If bank-run aggregates (natural) are used, they must be screened to separate the fine material from the coarse, and then recombined in the proper proportions. When all of the materials have been prepared, the correct amount of each material must be measured before mixing together.

1. The individual materials which go to make up concrete must be classified as to size, moisture content, and cleanliness.
2. The amounts of each material used to make the concrete will depend on:
    a. the required qualities of the hardened concrete, i.e., what it will be required to do.
    b. the required workability of the fresh or raw concrete.
    c. economy
3. All the materials must be clean.

B. Some foundation materials for concrete aggregates must be shaken through a sieve of known size in order to determine the size of the particles. When an aggregate has been separated into its coarse and fine constituents, these are then recombined in the proportions which have been specified earlier.

1. Aggregates are screened.
2. Screening involves the use of sieves of various sizes from fine to coarse.
3. Screening is done to separate the fine particles from the coarse.
4. The particles are then recombined in a predetermined proportion (allowing just so much fine to so much coarse).

C. The determination of the quantities of the individual materials (aggregate, cement, and water) that are to be mixed together (combined) to make concrete for foundations is called Measuring.

1. The quality of the concrete used in the foundations will depend to some extent on the care used in measuring the materials that go into the mixer.
2. Cement and aggregate are measured either by volume or by weight.
3. The amount of water used is very important: too much will make the concrete easy to work but will weaken it; too little will make it difficult to work and may cause the concrete to crack and deform in drying. The water must be very carefully measured.

VIII. Mixing

A. The individual materials, in the correct proportions, are combined, then rotated or otherwise agitated for a short period of time.

1. Individual materials are combined.
2. The combined materials are agitated to ensure a thorough mix.
3. This combining and agitating is done for only a short period of time--a matter of minutes.
4. Mixing may be done:
   a. in a plant (factory)
   b. by hand on the site
   c. by mechanical mixer on the site
5. If mixing is done on the site, it should be carried out as near to the point of use for the concrete as is feasible.
6. Concrete should be mixed not more than one-half hour before use, unless bulk concrete is used, coming from the mixing plant in trucks which gently agitate the fresh concrete.
7. A mixing plant may be built on site, and may be a very elaborate operation.

HANDLING FOUNDATION MATERIALS

Reading Assignment
Day 73

I. After the concrete has been mixed, it must be transferred to the point of use, placed carefully in position, agitated, and building ties or anchors are set in place, and the working surface finished.

II. Transferring

A. Concrete is usually transferred by one of three ways, or a combination of these methods: by hauling, conveying, or piping. Care must be taken to prevent segregation of the materials as the concrete is being moved. The method of transferring selected depends upon: the scale of the work, the restrictions imposed by the site, the types of equipment available, and the specifications.

B. If the concrete is mixed away from the site or the point of use, e.g., at a mixing plant, it may be loaded in trucks or small dump buggies and hauled to the point of use. On small projects, the wheelbarrow is still much in use.

1. Concrete (fresh) may be hauled to the point of use in trucks or in small dump buggies.
2. On small jobs, a wheelbarrow may be used.

C. The concrete may be conveyed or moved on a belt, or in a series of moving buckets from the point of mixing to the point of use--the forms. On large projects, such as dams, this may be a continuous operation.

D. The concrete may be forced through a pipeline to the point of use--the forms--by pumping, or by forcing it through hoses pneumatically.

1. Pumping is most commonly used in difficult situations, e.g., building a tunnel.
2. The pumping machine may also be combined with a mixing machine so that the entire operation involves a single process. The mixed concrete goes to a hopper, then through the pump to the pipeline and into the formwork.

III. Placing

A. The concrete is positioned between the forms as near as practicable to its final position.

1. Concrete should be placed in the forms continuously and evenly, and care should be taken to avoid segregation of materials in the concrete, or entrapment of air. Also, concrete should not be deposited in water.
2. Concrete is best placed in layers about 12 to 18 inches thick.
3. Concrete is placed by:
   a. dumping
   b. chuting
4. Concrete is "PLACED" not poured.
5. Horizontal movement of concrete in the forms should be kept to a minimum.

B. When using buggies, wheelbarrows, hoppers, etc., the concrete is dropped or dumped into the face of previously placed concrete or where needed (final position).
 1. Concrete is "PLACED" not poured.
 2. Concrete should not be dropped from a great height.
 3. Concrete is dumped into the face of previously placed concrete, not away from it.
 4. It is placed where needed, and should never be dragged or pushed into place, or caused to flow.
 5. Concrete is best placed in layers.

C. Concrete may be placed by means of a chute. The concrete is raised vertically and then distributed by gravity through chutes or channels to its final position.
 1. To obtain a uniform movement of concrete, the chute or channel must have a uniform slope.
 2. The slope of the chute or channel must be sufficient to cause the concrete to move readily.
 3. The slope of the chute or channel must never be excessive.

IV. Consolidating

A. Consolidating is achieved by manipulating or agitating (shaking) the concrete gently as it is placed in the forms. The entrapment of air is avoided and the forms filled completely.
 1. Agitating ensures against the entrapment of air, and helps to fill the forms.
 2. Concrete may be agitated in a number of ways, e.g., by vibrating, tamping, or puddling, or spading.
 3. It can be done by hand, or by machine.

B. Vibrating is usually done by immersing a tool called a Spud Vibrator in the concrete. This tool is powered, and vibrates at several thousand cycles per minute.
 1. Vibrating consolidates and improves the surface of the concrete next to the forms.
 2. Vibrators should never be over-used, as the shaking effect may cause too much water and fine sand to come to the surface (which, if it hardens later, is called laitance).
 3. Over-vibrating may also cause the formwork to spread or split.

C. Spading or puddling is a method of consolidating by hand. Spading is done by immersing the spade or paddle in the concrete and gently moving it about.

D. Tamping is usually done to force large particles of coarse aggregate slightly below the surface to enable the concrete finisher to put the desired finish on a flat concrete surface. It is also done to consolidate the concrete in the forms; however, tamping is usually done by hand, using a tool called a "Jitterbug," a flat metal grill with a handle. The tamper or "Jitterbug" should be used sparingly.

V. Anchors, Ties, Hangers
   A. Anchors are set in the concrete shortly after it has been placed to provide bases for subsequent erection of structural members.
      1. Anchors are bolts, plates, bars, or other devices used to connect the foundation or base with the superstructure.
      2. They are set in place after the concrete has begun to set, so that they will hold the position.
      3. Anchors may be held in place in the formwork, the concrete being placed and consolidated around them, then the holding members of the formwork are later removed.

VI. Finishing
   A. The type of finish required depends upon the use of the completed job, and the effect desired. Foundations are not normally finished in the true sense of the word, but certain aspects of the work do occur. Finishing is done by striking-off, edging, and floating.
   B. Striking-off is a leveling operation that removes humps and hollows and gives a true, even, concrete surface. Usually applicable to flat slab surfaces, some striking-off may be necessary in foundation work.
      1. It is sometimes called screeding.
      2. It is done by striking-off or moving a tool like a straight edge back and forth with a saw-like motion across the top of the forms, advancing forward a short distance with each movement.
   C. In Edging, all open edges should be rounded off to prevent chipping.
      1. This is done by moving a tool called an Edger: a trowel with a rounded edge along the edge of the concrete.
      2. The Edger should never be pressed too deeply into the concrete.
   D. When the concrete is hard enough that the weight of a man standing on it leaves only a slight imprint, and when all water sheen has disappeared, the surface should then be floated with wood, cork, or metal floats to remove slight imperfections and to help level and compact the concrete. Floating is usually done to give a fine finish to the concrete, and is more applicable to flat slabs than foundations; however, some floating may be necessary.

BONDING AND CURING

Reading Assignment
Day 74

I. Bonding is the adhesion of new concrete with old or previously placed concrete. The old or previously placed concrete is treated to ensure a good bond. This is known as a construction joint. Old or previously placed concrete usually has a laitance film--a chalky, low-strength muck which is formed on the surface. This film must be removed.

II. Preparing Surfaces
   A. Preparation of old or previously placed concrete surfaces involves scraping, washing and grouting.
   B. The former surface is scraped or scratched to a depth sufficient to reach sound concrete. Usually only about one inch or so of the old concrete surface needs to be scraped off.
   C. Clean water should be used to wash down and remove the loose, scraped materials.
   D. The old surface is then coated with the grout (cement/sand) to provide a bed for the new concrete when it is placed.

III. Jointing
   A. Apart from straight construction joints, there are also keyed construction joints which are stronger, and expansion and contraction joints which allow the structure to "breath."
      1. Straight construction joints are points of weakness.
      2. Keyed construction joints are stronger.
      3. Joints should be placed where it is convenient to stop work.
      4. Joints filled with elastic material should be provided when it is expected that the structure will expand and contract a considerable amount.
   B. The new concrete is placed on the grouted (sometimes keyed) surface in a thin layer (12 to 18 inches thick). This may be a continuous operation.
      1. The new concrete is placed in a thin layer.
      2. It is placed while the grout is fresh.
   C. The new layer of concrete is gently tamped or tapped down to ensure a good bond between the new and old work. Tamping is simply done by gently tapping the surface with a tamper or Jitterbug.

IV. Curing
   A. Curing is one of the most important steps in the construction process using concrete. The curing or setting of concrete involves time. It is the control of moisture content and/or temperature of the concrete during the setting or hardening period to ensure watertightness and increase strength.

V. Controlling Moisture

- A. Part of the curing process involves the conservation or prevention of excessive evaporation of moisture in the concrete.
  - 1. The evaporation of water, or too rapid drying out, should be prevented.
  - 2. Curing or hardening of concrete occurs because of a chemical reaction between the water in the concrete and the cement. Thus the water content is very important and must be controlled.
- B. Ponding and Flooding is a form of curing called water curing. It consists of providing a constant supply of water to the concrete to prevent loss of moisture. In flooding or ponding, an enclosed area of concrete is kept flooded with water.
  - 1. A small dam of earth or other water-retaining material is placed around the concrete perimeter.
  - 2. The enclosed area is flooded with water.
  - 3. The constant supply of water prevents the possibility of crazing or cracking which might be caused by alternate wetting and drying.
  - 4. The constant water supply prevents loss of moisture from the concrete itself.
- C. Another method of water curing concrete is called Mist Spraying. A fine spray of water is applied continuously through a system of nozzles to keep the concrete moist.
  - 1. The spray method is most effective when applied continuously.
  - 2. An adequate supply of water and careful supervision are required.
  - 3. It prevents crazing or cracking due to alternate wetting and drying.
- D. Curing may also be accomplished by covering the fresh concrete with water retaining materials, or by applying mechanical barriers, such as waterproof paper or plastic film to seal in the water and prevent evaporation.
  - 1. Water retaining materials may be placed on top of the concrete to prevent loss of moisture.
  - 2. Examples of water retaining materials would be wet sand, burlap, or straw.
  - 3. If mechanical barriers are used, they should be applied as soon as possible after the concrete is placed.
  - 4. Mechanical barriers also have the advantage of preventing falling leaves or debris from damaging the concrete.

Reading Assignment
Day 74 (continued)

E. In treating by chemicals, a chemical is sprayed on the fresh concrete and forms a membrane or skin which seals in moisture.
    1. They may discolor concrete.
    2. They keep in moisture.

VI. Controlling Temperature
  A. New concrete must never be allowed to freeze, or to become too hot. Insulation blankets will help prevent freezing. Sprinkling of fresh concrete and the use of chilled or cooled materials will help to keep the concrete from becoming too hot in warm weather.

REMOVING FORMS AND FINISHING

Reading Assignment
Day 75

I. When the concrete has cured—the amount of time required for curing varies with the type of concrete --the formwork may be removed or stripped away from it.
  A. The concrete must be properly cured before the forms are removed.
  B. Great care must be exercised in removing formwork.

II. Stripping Formwork
  A. The term most commonly used in removing forms is Stripping. It is a form of disassembling.
    1. Stripping is the removal of formwork.
    2. Care must be taken not to damage the concrete when stripping forms.
    3. If forms are to be reused, care must be taken not to damage either the forms, or the concrete.
    4. Where complicated formwork exists, as at a corner or other projection or detail, work should begin away from the detail moving in toward it as the forms are dismantled.
    5. Wedges should not be inserted between the form and the concrete as these can cause damage to the concrete.
  B. Unfastening is to dismantle or strip the forms. It may be necessary to draw nails out, unbolt or unscrew the members which make up the form or its bracing or shoring.
    1. Care must be exercised to avoid damaging the concrete.
    2. Forms may be dismantled or stripped piece by piece, or in units or components, depending upon the complexity of the formwork design.

C. Formwork may be gently tapped to help separate the form from the concrete.
   1. Tapping should be kept to a minimum.
   2. If tapping is used, it should be done very gently and with great care so as not to damage the concrete.
   3. The vibrations caused by the tapping help to separate the concrete and the forms.

D. Pulling is usually associated with the removal of sheathing. A clamp or grip is fixed to the upper section of the sheathing or form (which has already been pried loose--if feasible), and the sheathing or planking is then pulled up and out of position.
   1. A rig and clamps or grip are used in pulling formwork.
   2. The formwork or sheathing is first pried loose--if feasible.
   3. The clamps are then fixed to the form and it is pulled up or extracted like a tooth.
   4. The shoring and bracing must be removed before pulling operations begin.

E. The forms, once stripped from the concrete, are lifted or carried away from the working area and stacked for transportation from the site or for reuse.
   1. Cranes or other mechanical equipment are often used to lift and stack formwork.
   2. Formwork should be stacked away from the working area so as not to interfere with the construction process.

III. Cleaning Formwork
   A. If the forms are to be reused, they must be cleaned.
   B. Forms are chipped or scraped to remove any concrete or dirt adhering to them.
   C. When the forms have been chipped and/or scraped, they should be washed to remove any remaining loose material.

IV. Stockpiling
   A. When cleaned, the forms should be stacked in piles in a convenient position for transportation from site, or for reuse.
      1. Stockpile forms so that they do not interfere with construction progress, so that they are convenient for reuse or for loading for transportation from site, and safe from damage.

V. When the forms have been removed, it is likely that some damage may have occurred. These damaged spots must be repaired and the foundation cleaned off and backfilled.

VI. Cleaning and Damp-proofing

A. Many foundation walls serve the dual purpose of supporting a structure and at the same time enclosing a usable space, in which case, the walls must prevent the penetration of moisture.

1. Foundation walls may enclose usable space, e.g., a basement, or workroom.
2. Moisture from damp soil or from other sources will penetrate such walls unless precautions are taken in building and finishing them to ensure that they be waterproof.

B. Foundation walls may be rough when the forms are removed. These small pits should be filled in and smoothed off, especially if some form of waterproofing is to be applied to the walls.

C. Any sharp projections remaining on the surface of the foundation walls should be removed--these are usually chipped or chiseled away.

D. Careful handling of the concrete as it is placed in position will go a long way toward improving the foundation resistance to damp penetration. However, when the foundation wall is completed, a damp-proof membrane may be applied which will aid in keeping water from penetrating the walls (and floor slab).

1. Careful handling (placing) of the concrete helps ensure a damp-proof foundation (wall).
2. The thicker the wall or floor slab, the greater the possibility of its resisting damp penetration.
3. A waterproof membrane made of asphalt or coal-tar pitch or other such material may be applied to the outside of the wall.
4. This membrane seals out the damp.
5. The membrane itself may be further protected by building a brick or special board facing in front of it.
6. Alternatively, the concrete may be treated with chemicals during its preparation to make it waterproof.

VII. Backfilling

A. Backfilling, sometimes more specifically referred to as fill, backfill, or embankment construction, is often referred to also under the general heading of "disposal of excavated material." It is the reuse of material excavated on site, but may involve the use of material brought from outside to the site. The actual material used will depend upon the task the backfill, or "disposed material" is expected to fulfill.

1. Backfilling, in this context, usually means the reuse of excavated material around or over buried, or partially buried, structures--generally using materials originally excavated from the same site.
2. Backfilling may involve the use of bulldozers, manpower, and will generally require compaction of some sort.

B. A bulldozer or other earthmoving equipment may be used to move the excavated material from its temporary position to fill the areas around the structure--in this case, the foundations.
   1. Tree stumps and other debris should be excluded from backfill materials.
   2. A bulldozer is commonly used to push the material into the cavity around a structure or against a structure.

C. When the material has been placed in position in, around, or on top of, the structure, it should be compacted to produce the greatest density of the particular material (soil) being used.
   1. The aim of compacting is to achieve the greatest density of the particular soil or material being used for backfill.
   2. The moisture content of the material is very important, as it allows the grains of the material to slide into their final position.
   3. Material which has been stockpiled for a long time may be dried out and require moistening before use.
   4. Soils can be compacted by
      a. applying a heavy weight to press the grains together
      b. applying pressure and working the material--kneading
      c. vibrating to shake the grains together
      d. by pounding the soil mass
   5. Rollers, sheepsfoot rollers, pneumatic tired rollers and tampers are all used for compacting soils.

BUILDING THE MAJOR STRUCTURAL ELEMENTS

Reading Assignment
Day 76

I. The major structural elements are those members which give permanent form, support, and rigidity to the structure.

II. Either or both of these structural types may be built on or off the site.
   A. Frame construction is usually thought of as consisting of elements that provide linear (long--narrow) support. Column materials used for frame construction are steel posts and beams, timber posts and beams, steel-reinforced concrete columns and beams, etc. More sophisticated types of framing are geodesic framing, and inflatable balloon structures. Generally, steel structures are "lighter" than concrete or mass construction, and are also faster in the building.

Reading Assignment
Day 76 (continued)

B. Bearing structures are usually thought of as consisting of elements of planer (surface area) support. Typical supports are mass concrete walls and floors, or brick and/or block bearing walls.

III. Elements of Any Structure

A. All structures have a base or foundation which consists of bearing pads (footers) and rising walls.

B. Most structures have vertical and horizontal members consisting of columns, posts, beams, joists, spreaders, rafters, walls, floors.

C. Some structures may be a composite of the above by combining various types of structures and materials.

IV. Regardless of the type of structure, material, or element, it will be necessary to prepare the material or component, handle the material, that is, move it into position, and assemble the material.

PREPARING STRUCTURAL MATERIALS

Reading Assignment
Day 77

I. The principle idea of preparing materials is to get them ready for use so that steady or uninterrupted assembly can take place.

A. All materials come to the site preprocessed in some way. They have already been given their rough dimensional shape.

B. Further refinement of the material shape and condition is usually necessary to make it suitable for assembly.

C. The material for structural elements is usually in the form of lengths of bars with the exception of concrete.

D. Materials are usually prepared as individual pieces, or assembled components, or may be completely prepared off the site by the manufacturer.

E. Many of the practices involved here are used in earlier stages of construction, the types of materials and the degree of accuracy, however, change. Greater accuracy and finer workmanship are necessary.

II. Laying Out

A. Laying out means to determine the shape of the piece of material by measuring and marking points and lines, to proportion the material.

B. Unless the material is pre-prepared, it is necessary to identify the material shape.

Reading Assignment
Day 77 (continued)

C. Material is measured or dimensioned according to specifications or the building plan. It is then marked to indicate the shape for cutting.

D. Included in layout are the locations of points, angles, lines, and other contours.

E. When many identical lengths are laid out for cutting, a jig may be positioned on the saw--thus alleviating the need for layout.

III. Cutting

A. Cutting means to separate material by removing away parts of it according to the layout.

B. Materials are cut to make them fit with other parts in an assembly.

C. The type of material determines the type of tool to be used.

D. There are many ways to remove materials, e.g., sawing, drilling, shearing, burning, planing, shaping, abrading, etc.

E. Concrete may be cut by abrading, steel by sawing, or burning, and wood by sawing. In sawing metal, the teeth are smaller than in sawing wood.

IV. Forming

A. Forming means to change the shape of material without adding to it or removing material from it. This is usually accomplished by working the material or thermal conditioning, and then working it.

B. To give concrete its shape, it is necessary to build forms for casting its shape.

C. Steel may need to be heated and bent.

D. Wood may be bent by placing it in a form, or supporting it by force, to create a given shape.

V. Mixing and Proportioning

A. Porportioning means to combine materials through careful measurement. Mixing means to stir or agitate materials.

B. Typical materials that are mixed are paint, sealers, concrete, mortar, etc.

VI. Treating

A. Treating means to coat, or otherwise treat, the material to increase its durability.

B. It is easier to treat a structural member prior to assembly than after it has been positioned in the structure.

C. Treating includes the painting or soaking of a member to protect it.

D. Structural members may be exposed to the weather for some time, and thus need to be protected against rust, rot, mold, insects, etc.

FABRICATING COMPONENTS AND TEMPORARY FORMS

Reading Assignment
Day 79

I. Components of the structural elements and temporary formwork may be fabricated on or off the site. These elements or pre-assembled units or parts facilitate the ease with which the structure is built, by reducing the number of parts to be handled and assembled.

II. Preparing Materials
  A. The same procedures of layout, cutting, forming, proportioning, mixing, and treating are employed.
  B. In the case of formwork for concrete bearing structures, formwork needs to be continuously prepared, assembled, and stripped.
  C. Concrete beams, columns, floors, and walls may be made on the site by placing concrete in the form.
  D. Temporary braces may be needed to hold steel beams, wood beams, in place so that they can be fastened together.

III. Sub-Assembling
  A. In some cases, groups of components are assembled into larger assemblies and the whole sub-assembly can be placed in position for fastening.

IV. Setting Reinforcement
  A. As before, if the structure involves the use of reinforced concrete, the reinforcement must be cleaned and shaped, transferred and placed in position in the forms, and supported in place until the concrete is placed.
  B. Accuracy in placing is extremely important in setting reinforcement.

HANDLING MATERIALS AND COMPONENTS

Reading Assignment
Day 81

I. Once the material has been prepared for assembly, it must be moved into position.
  A. Material handling is a recurring procedure.
  B. The weight and size of the structural member determines how it will be handled.
  C. The extent of the operation will depend upon the distance the material or component must be moved, its size, shape, and weight.

II. Transferring

A. Transferring is the combined activities of grasping or attaching, lifting, carrying, lowering, and releasing.

B. Solid members must be grasped or attached to the prime mover, lifted and moved in some direction, lowered and released.

C. Hoisting means to raise by power--usually with a crane in this context. Structural elements must be attached securely to the crane hook and balanced. As a structure is erected, sometimes elevators are attached to the skeleton to hoist structural members or hoist concrete.

D. Carrying means to move horizontally. Once the material has been hoisted, it must be moved to its proper location. Motorized wheelers carry concrete. A crane may swing the elements into position. When the crane operator and director of assembly are far apart, they may communicate signals either by walkie-talkie, or by arm signals.

III. Positioning

A. Positioning is the act of locating, holding, and aligning any structural element so it can be fastened. Care must be taken in positioning structural elements to avoid damage.

B. The initial act of positioning is to locate the element in its proper relationship to the structure.

C. To keep the structural element stable for fastening, it may need to be braced or held. It may be necessary to maintain the component in position temporarily until it can be aligned and fastened.

D. Aligning means to level or adjust structural members in their proper position for fastening. It is a refining action of positioning. If the element is not properly aligned, it will cause other members to be ill-fitting and throw off the dimensions of the structure. Alignment takes place in two directions: vertical and horizontal.

E. In placing concrete, care must be taken to avoid separating the water from the aggregate mixture.

IV. Assembling

A. Assembling means to combine materials either by adhering, cohering, or by mechanical linkage. It is the act of putting elements together to form a larger whole.

1. The heart of building process is the practice of assembling elements to give the structure its shape.
2. Structural elements must be assembled securely to provide the strength necessary to carry the weight and augment the rigidity for the application of additional elements.
3. Elements may be assembled as individual pieces or as components.

Reading Assignment
Day 81 (continued)

B. Fastening means to join together by mechanical linkage. Due to the many parts in a structure that need to be fastened, fastening becomes a time-consuming and repetitive task. The material and the type of joint desired determines the tools to use and the procedure. There are many ways of fastening pieces together.

1. Pinning means to insert a pin (bolt, nail, screw, rivet) to hold pieces together. The worker's skill in fastening parts together determines the rigidity of the joints, and ultimately, the stability of the structure.
2. Welding is the fusion of metals by heating and melting them together with the addition of a filler rod. Welding can be accomplished in many ways, but on the site, it is usually done by electric arc welding, or by oxy-acetylene torch.

C. Bonding means to join together by adhering, or cohering (making the member itself serve as an interlocking device). There are many types of bonds--glued, cemented, keyed, applied coatings. Bonding, in this context, is concerned with concrete and wood.

1. Jointing refers to working with concrete in making the surface such that additional layers will tend to stick or adhere.
2. Adhering means to stick together with a mutual substance. Wood is bonded with glue; when built in layers it is called laminated. Glue can be applied in many ways: brushing, spreading, spraying, rolling, or dipping. Glued pieces are usually clamped under pressure while drying.

TREATING STRUCTURAL ELEMENTS

Reading Assignment
Day 83

I. All structural elements are treated in some manner, either before, or after, assembly. Treating may include curing concrete, tensioning or pre-stressing concrete, pressurizing or inflating rubber forms, coatings for preserving or protecting the material, and fireproofing.

II. Curing

A. All concrete, and in some cases glues and mastics, must be cured to develop their rigidity. Curing may include the control of material's temperature during the process.

III. Tensioning

A. Pre-stressed or reinforced concrete may need to be tensioned, that is, pulling and tightening the stress bars or cables to increase their strength and stability. Tensioning also gives some form to the concrete by deflection (bending).

Reading Assignment
Day 83 (continued)

IV. Pressurizing
   A. **In some cases, the major structural element may be solely a rubber skin, in which case the bag or balloon must be inflated by pressure. Also, some balloon structures may serve as forms for concrete work, which may be deflated when the concrete is rigid.**

V. Coating
   A. **Coating includes any type of preservative or protection for the material. Included are paints, varnishes, rust-preventatives, insect repellents, etc.**

VI. Fireproofing
   A. **Steel members of the structure may be covered with a layer of concrete or other fire retardants. Wood members may be fireproofed with metallic paints, or impregnated with fire-retardant chemicals.**

VII. Removing Temporary Forms
   A. **Any formwork needs to be removed after the completion of the process.**
      1. **Forms are stripped.**
      2. **Forms are cleaned.**
      3. **Forms are stockpiled.**

VIII. Finishing
   A. **Structural members which are completed and will be exposed to view may be finished. This may include coating the surface by spraying, brushing, or rolling on the finish material.**

INSTALLING CIRCULATORY SYSTEMS

Reading Assignment
Day 86

I. **The purpose of installing circulatory systems is to provide environmental conditions that are necessary for humans and materials, both during the construction phase, and afterward. Included are those services and equipment which provide air, water, heat, light, sanitation, communication, and access. These are generally made up of manufactured products.**
   A. **These activities occur and continue throughout the building process. Since the bulk of these installation practices occur after the major structural elements are in place, they have been included here prior to Finishing the Structure.**

B. All structures have some sort of circulatory system.

C. In buildings, heating equipment may be installed in the substructure, and ductwork or piping installed as the structure progresses. The final vents or thermostats and such are installed after the walls have been finished.

D. In a building, installation of sanitary facilities occurs at all stages of the building process. Even before the foundation is set, connecting lines to existing sewers may be joined. A plumbing tree is erected along with the erection of the structural elements. Pipes are laid in floors, and positioned in walls to various outlets. The final fixtures are attached in the finishing stage.

E. Other similar examples are electrical wiring, elevators, ventilating and cooling services and equipment.

F. Roads may have sewer facilities under their surfaces and these must be installed prior to their surfacing. Some roads have auxiliary lighting, in which case electrical lines must be strung and the posts and lights installed.

G. Tunnels need lights and ventilating facilities.

H. Towers may need lighting and in some cases, heating and sanitation, as in the instance of a lighthouse.

I. Dams may have all of these services and equipment.

J. Bridges may have lighting, communications, and in some cases, heating to prevent ice formation, and they also require temporary access for men and machinery during construction.

INSTALLING UTILITIES AND MECHANICAL PLANT

Reading Assignment
Day 87

I. Water, sanitary equipment, power, light, heat, ventilation, and vertical transportation must all be fitted into the construction process. Their installation begins with a connection to the public service during the early days of the construction process, and continues to develop as the structure takes shape. The practices involved include plumbing, wiring, preparing materials, handling materials, fastening materials in place, connecting and joining.

A. The mechanical plant includes elevators, escalators, hoists, chutes, shafts, and stairs.

B. Almost all trades and most materials may be represented in installing permanent utilities and mechanical plant.

PREPARING MATERIALS AND COMPONENTS, FASTENING AND JOINING

Reading Assignment
Day 38

I. The installation of permanent utilities and mechanical plant involves the use of materials. In this case, some of the materials are pre-prepared and ready for installation. Others, however, will require preparation before they can be fit into the structure.

II. Preparing Materials and Components
   A. Specifications for positioning of the utilities and mechanical plant set forth the dimensions, locations, and sizes of the components to be installed. Laying out involves the measuring and marking of shapes and patterns on both the material and the component to be installed.
   B. Excessive material must be removed in accordance with the pattern and/or marking made during the layout. Materials may be cut in many different ways. The same techniques are used as in Building the Structure, but the degree of fineness and the type of material being cut is changed. Metals, woods, brick, and block can all be sawed.
   C. The shape or form of the material may have to be altered so as to fit the structure, and connect with other components. The relative angles of the material are adapted to a specified pattern. Pipes, metal sheets, or bars, plywood, or other materials, may have to be re-shaped. Pipes are bent to specified angles using a pipe bending machine. Sheets are made to take on a new form by using clamps, vises, etc., to hold them temporarily until they can be fastened permanently.
   D. Many components need to be painted, greased, oiled, fireproofed, given preservatives, etc., both for ease of assembly and for future protection of operation prior to their final installation.
   E. The fabrication of components consists of laying out according to specifications, cutting the parts, and re-shaping them, and finally assembling the parts into components. This may be done on or off the site.

III. Handling Materials
   A. When the materials and/or components have been prepared they are taken to the structure for installation. Two basic steps are transferring and positioning. The nature of the materials being handled calls for considerable care. For example, delicate machinery or light duct components cannot be handled with the same freedom as a steel beam.
   B. Components are lifted, carried, hoisted, or jacked into the area in which they are to be installed. Care must be exercised to avoid damage.

C. Components are first positioned roughly, then they are aligned and oriented with respect to their function and the position they will finally occupy in the structure.

IV. Fastening in Place

A. Having located the component or material with respect to its final position, it must be attached to the structure or held rigidly in position.

B. Some components may be attached to the structure by means of pins (bolts, screws, nails, rivets, dowels). Generally, the size of the pins will be smalled than in Building the Structural Elements. Some exceptions might be the bolts for large motor mounts or elevator equipment.

C. The welding process is much the same for component installation as for structure erection. Care must be taken in welding to avoid distortion due to heat. Welding is often done in stages to avoid this problem. An advantage of welding is that components can be assembled in a continuous form and the fastening is a part of the component and/or structure.

D. Components may be fastened by hooking or suspending on bent metal, or other material. Hooks are used particularly in fastening pipe work or wiring; slings or closed hooks are also used.

E. Components may be fastened in place by interlocking clamps or stirrups.

F. Components may be imbedded in the surrounding structure. Heavy components, especially, may require special seating. Provision for imbedding utilities and/or mechanical plant in the structure is made during the building process. Its great advantage is space saving, and usually, good appearance. The major disadvantage is that, should the utility or plant require repair or replacement, there is a serious problem of access. Heavy mechanical plants may require special seating or cushioning to prevent excessive noise from traveling through the structure, and prevent vibration which might damage the structure.

V. Connecting and Joining

A. The individual components that go to make up the utilities or mechanical plant must be joined together--usually in position in the structure.

B. Components may be bonded together (joined with the aid of material which glues or adheres to both units). Glue, cement, etc., may be used to bond or join materials.

C. Components may be joined by bolting, screwing, nailing, doweling, or riveting, i.e., a pin is used to pierce both components.

D. Both arc welding and oxy-acetylene welding are used to join components. Care must be taken to avoid distortion due to excessive heat buildup. Ductwork is often welded because of the continuous nature of the task. Soldering is used, particularly in electrical work. Before soldering, all joints should be made mechanically strong. In electrical work, no acid should be used in soldering.

E. In splicing, the ends of two sections of a material are lapped and bound, or joined with a metal plate. Cables may be spliced, ductwork may be overlapped and bound or wrapped.

F. In socketing, one end of a component is designed to lock into a prepared housing in another. Pipes are commonly joined by sockets, i.e., the enlarged end of one pipe is designed to receive a similar pipe. It is made permanent by pouring molten lead or cement mortar into the joint. Other types of sockets include toggle joints, where the component has a ball-shaped head which is set in the structure, ball and socket joints, pivet joints.

G. Treating, in this context, relates to the steps taken to prevent attack on the utilities or mechanical plant by corrosion, or by climatic conditions such as freezing. Pipes may be lagged--coated or encased or wound--with insulating material to prevent freezing or excessive heat loss. Ductwork may be scoured and painted with a preservative to prevent rust. Treatment is usually' done before placement, or after.

PROVIDING TEMPORARY EQUIPMENT

Reading Assignment
Day 89

I. In order to gain access to all parts of the structure for working, scaffolds, hoists, elevators, steps, ramps, etc., may have to be built or provided. These accesses are temporary and may be built especially for the job or brought on site in prefabricated units. A major consideration in providing these accesses is the safety of personnel. Such accesses are known as the contractor's equipment. Materials in storage on site must be protected against damage from weather, construction materials, against theft.

II. Handling Equipment

A. Contractor's equipment is usually prefabricated, i.e., scaffold parts are brought on site--no preparation is necessary--and assembled in place. The equipment may need to be sorted, transferred and positioned, when needed.

B. Depending upon the size of the component, it may be carried, or hauled (by truck or other vehicle) or lifted to the place where it will be used.

C. Components are roughly positioned, placed where needed, oriented, and aligned.

D. When the components have been positioned and aligned, they must be fixed in position and fastened together, and sometimes attached to the structure for additional support. Scaffolds are usually pinned together, or may be welded for additional safety. When fasteners may damage the structure, clamps should be used.

III. Securing in Place

A. For safety reasons, temporary equipment such as scaffolding must be secured with sufficient strength to support men and equipment. Most temporary equipment is designed for easy and quick assembly, disassembly and maneuverability.

B. Pins common to quick set-up equipment are bolts and nuts, toggle pins, and drift pins.

C. Occasionally, members may need to be welded for additional strength and safety.

D. Clamps may be used when pins are not feasible, such as when fastening the scaffold to the structure may damage the structure.

E. An alternate method of securing is by tying or binding supports with rope or wire.

F. Scaffolds may need additional bracing for stability and strength.

G. Some scaffolds that perform an elevator function may be hooked to roof members.

H. In some cases, safety nets may be required.

IV. Removing Temporary Equipment

A. Once work has been completed, the temporary equipment must be removed to allow work to proceed. It may be moved to another location on site.

B. Most temporary equipment is disassembled when there is no longer a need for it.

C. Temporary equipment must be removed from the working area. It is usually loaded on trucks and hauled to predetermined points on the site for stockpiling, or it may be removed from the site for use elsewhere.

FINISHING THE STRUCTURE

Reading Assignment
Day 91

I. Structures are finished to protect humans and materials against natural forces, and to make the structures operational and complete.
   A. All structures need to be protected in some way against deterioration and the effects of use.
   B. Buildings are the most complex structures to finish due to the variety of exterior and interior finishes.
   C. Rough-finishing includes all surfaces and materials which will eventually be hidden from view and which perform a sheltering or enclosing function.
   D. Fine finishing includes all the completed or finished surfaces to be visible and/or all surfaces which perform an enclosing function of interior space.
   E. Examples of enclosures are subflooring, subsidings, subroofing, Examples of fine finishing are brick veneer, roofing, siding, paneling, painting, plastering, etc.
   F. A structure may be totally enclosed, partially enclosed, not enclosed at all. However, it will still require some kind of protective coating. Radio towers are virtually major structural elements, but require lighting and painting to fulfill their intended purpose. A picnic shelter, or carport, may be open on the sides, but still need subroofing and finish roofing as well as coating, to preserve the exposed structural elements. A house may be totally or partially enclosed and need to be finished inside and out.
   G. This stage of production includes the greatest number of diverse skills and workers, i.e., masons, carpenters, tinsmiths, plumbers, electricians, painters, glaziers, etc.
   H. The degree of skill and accuracy needed in the work in this stage becomes increasingly more exacting.

ENCLOSING THE STRUCTURE

Reading Assignment
Day 92

I. To protect humans and materials against natural forces, a barrier must be established between the exterior and interior of the structure. Included are subfloors, subroofing, subsiting, but not the coating or trim of the exterior or interior. Enclosing the Structure includes all surfaces and materials which will be hidden from final view, and some surfaces which do not require additional finishing.

Reading Assignment
Day 92 (continued)

A. Usually [illegible] buildings will be enclosed.
B. The materials used are more often in sheet forms than in bar lengths (as were the structural members).
C. Siding materials include wood, metal, brick, glass, fiberboard, plastic film, fiber paper, and insulation.
D. Enclosure is usually associated with frame structures.
E. Elements used in the enclosure of a structure usually serve two purposes:
   1. to enclose or divide space
   2. to protect from the elements.

   They are rarely load-bearing, being of light construction, and usually planar in form.

PREPARING, HANDLING, AND ASSEMBLING COMPONENTS AND MATERIALS

Reading Assignment
Day 93

I. The first stage of enclosing is to prepare the materials. This operation is duplicated many times. The degree of accuracy in laying out and cutting becomes more critical in this stage. Tools become increasingly precisioned as the finishing demands greater accuracy and refinement. Care must be taken to avoid damage to the materials.
   A. Laying out is the determination of the shape by marking on the material the outline of the shape. Usually, this is the marking off of lengths or the setting up of appropriate equipment to eliminate the need for marking each piece.
      1. For example, boards need to be marked to fit the studs in a frame. The ends of the boards must coincide with a stud.
      2. The positions of pipes or other members which may penetrate the material must be marked so as to allow for the accurate removal of surface material.
   B. Cutting is to separate a part of the material from the whole, for example, by sawing or chipping.
      1. The material being cut and the purpose of the cut usually determines the tools or type of equipment to be used.
   C. Forming gives shape to the material without removing or adding to the material. For example, by bending, or casting.
   D. Mixing is the association by blending, kneading or impregnating materials into one mass.
      1. Types of materials commonly mixed at this stage in construction are paint for undercoats, mortar for masonry, and plaster.

E. Temporary formwork may be required throughout this stage in construction for the casting of concrete floors, roofs, walls, and some decorative features.
   1. Materials used for temporary formwork include timber, plastic, metal and cork. The type of material is usually specified.
   2. All forms must be accurately made and carefully assembled with tight joints.

F. Components are often joined together to form a unit before being placed in position on the structure.
   1. Common units treated in this way include window and door frames, partition units. These may be made up on the site, but are usually built elsewhere and brought to the site ready for installation.
   2. The prefabrication of units speeds the enclosing process, thus minimizing the exposure of the structure to the weather.

G. Wood siding may be treated with chemicals or preservatives to repel insects and water, and to prevent corrosion due to weathering. Painting is a normal method of preserving materials.

II. Handling Materials and Components

A. The way the material is moved depends upon its weight and location on the structure. Heavy machinery may be used to reach heights on the structure.

B. Transferring is a continuous process throughout the enclosing operation. The type of material determines how it is moved, also the distance it must travel.

C. Block-laying is a good example of positioning. Each block must be positioned and aligned. Panels may be first tacked into position to hold them in place, and the next panel aligned with them. The material must stop and start on a structural member so it can be fastened. Subfloor planking may run at angles for increased stability. Subsiding may also run at angles for increased rigidity.

III. Assembling in Place

A. Assembling is to combine often disparate elements into a whole. Included are the total exterior subsurfaces (subsiding, roof-framing, and underlays, subflooring). The tools and materials used in assembling determine the procedure and the method of fastening.

B. The mostcommon method of fastening wood is by nailing, while metal may be bolted, screwed, or snapped into place.

C. All kinds of metal may be welded--each calling for a particular method. Surfaces to be welded must be clean, and the edges to be joined should fit closely.

Reading Assignment
Day 93 (continued)

D. Bricks and blocks are laid up in various formations and bonded together with mortar. Brick is watered down before it is laid. Mixing and laying are continuous operations. Wood panels may be glued to the subelements for additional strength.

E. Metal paneling may be clipped or snapped onto the subelements.

COMPLETING THE STRUCTURE

Reading Assignment
Day 102

I. Completing the structure means to make it operational and complete. Included are all of the interior partitions, doors, windows, hardware, surfaces finishes and trim on the structure. Fine finishing entails more exacting skills, and high standards of workmanship. This stage includes all surfaces and materials visible and the final surface treatment.

   A. Buildings are usually finished inside and out to make them humanly operational, pleasing, and functional.

   B. Fine finishing includes the application of final surfaces and trim to prepared subsurfaces, the installation of vents, lights, sanitary equipment, communications, mechanical equipment, finished floors, paneling for walls, ceilings, and the removal of debris and workers' equipment.

   C. Fine finishing duplicates many of the previous practices.

   D. Fine finishing deals with the treatment of surfaces and the installation of accessories.

   E. Materials are of higher quality, and are usually in shapes for large area coverage---panels, sheets, rolls, etc.

PREPARING SUBSURFACES AND MATERIALS

Reading Assignment
Day 103

I. The purpose of this stage is to make ready the surfaces of the structural elements, or the rough finished surfaces for final trimming.

   A. Included are filling holes in subsurfaces, sanding rough spots, attaching grounds for the application of paneling to receive the finished surface. Once the structural or non-structural members are covered, they must be surfaced to receive a final finish. Wood structural members may need to be trued. Concrete bearing walls to be finished may be keyed or smoothed.

B. Abrading means to rough up a surface so that other material will adhere to it, or to smooth a surface so that the characteristics of the final surface will be brought out. Any surplus material is removed in this process. Concrete subfloors may need scraping. Wood, plaster board, concrete, plaster, metal surfaces, may need smoothing up.

C. Grounding means to attach auxiliary material to facilitate the application of additional material. For example, concrete, block, or any planar surface may be paneled. In order to provide for the fixing of these panels, grounds or battens are fixed directly to the subsurface at predetermined intervals related to the size of the panels. A high degree of accuracy is required in placing grounds to ensure the accuracy of final fit when finished surfaces are applied.

II. Preparing Materials and Components

A. The highest form of building skills are employed in preparing materials in this stage. Layout and cutting must be extremely accurate to make high quality joints. Blending paint colors needs to be exact in this stage. Craftsmanship shows itself in finishing. Included in this stage is layout, cutting, forming, mixing, making temporary formwork, assembly of prefabricated components, and treating.

B. The marking and measuring of pieces to be fitted together must be extremely accurate. More contours and angles are encountered than in other stages. The variety of materials is increased in this stage; for example, flooring varieties are cork, polished cement, slate, linoleum, plastic, ceramic tile, hardwood, softwood, terazzo, and carpeting. Materials are generally required for large area coverage, and are of high quality.

C. The tools used in fine finishing are of a greater variety and of a higher precision. Care must be taken to avoid waste in cutting, as the materials are usually expensive. To ensure greater accuracy and a close fit, a high degree of skill and workmanship is required.

D. The forming of finishing materials is rarely done on site. These materials usually arrive on site already shaped and cut to the required sizes. For example, fireplaces, range hoods or other canopies, metal handrails, bannisters, signs, arrive on site preformed.

E. The variety of materials to be mixed is greatly increased in this stage; for example, mortar, paint, plaster, concrete, terazzo, adhesives, waxes, polishes, sealers, etc. The degree of proportioning accuracy is increased, especially where colors are involved. Materials may be mixed by hand or machine. Mixing is usually done in compliance with the manufacturer's instructions. Some materials may be pre-mixed.

F. Poured floors usually require a form to contain the ingredients. For example, terazzo floors use metal forms which become an integral part of the floor. Poured floors, plaster ceilings and walls, require forms to regulate the boundaries and the depth of the applied material. The making of these forms requires the same practices as related earlier. The form materials used in fine finishing may be of high quality and they may be required to impart texture to the materials being formed.

G. Prefabricated components are assembled and installed on the site. Included are doors, windows, cabinets, fixtures, fittings (sanitary goods), hardware, etc. Mechanical equipment is made off the site and assembled on site.

H. Many materials are given a subcoat or base coat of paint or preservative prior to final assembly and installation. Finished materials are treated to prevent crazing, cracking, peeling, etc., and to provide ease of final finishing.

TRIMMING

Reading Assignment
Day 106

I. Trimming includes the final assembly, fastening, and coating. It is the last stage in changing material form. . Also included in this stage is removal of debris and contractor's equipment, which is no longer required. Trimming includes the final painting, attachment of molding, light fixtures, polishing floors, etc. Trim materials usually serve the additional purpose of presenting a good appearance and a good wearing surface. All structures have some form of trim; for example, roads need to be striped, bridges painted, tunnels lighted and signposted, towers painted and lighted, and other final connections made.

II. In view of the relative delicacy of the materials being handled at this stage, considerable care must be taken to avoid damage, as such damage (scratches, dents, chipped edges) will be visible when the work is completed. The usual high quality of finish materials means that their cost is greater than for rough finish materials. The finished materials (trim) are often decorative; therefore, care must be taken in keeping surfaces clean.

A. Finish or trim materials are usually transferred to their final position by hand. This will depend, however, upon the extent of the work, the weight, and relative awkwardness of the material, and its final position. For example, bronze or copper trim, if in large quantity or size, may be transferred by crane or hoist. Whatever the method of transferring, care must be taken to avoid damage to the material.

B. All trim materials must be positioned with great accuracy to ensure close fit, especially in the case of repetitive work such as wood paneling or metal facing. Trim materials are aligned and plumbed (leveled) and any adjustments made before they are fastened in place. Care must be taken to avoid damage.

III. Fastening and Connecting

A. Close fit and tightness of joints are essential to ensure permanency and good appearance. A high degree of skill and workmanship is necessary. Care must be taken to avoid damage to the materials.

B. Trim materials may be fastened in place by pinning, i.e., nailing bolting, screwing, etc. The pins used, however, are usually small in size and are more expensive and of higher quality than those used prior to this stage. These pins are often hidden from view in finish work or are countersunk, i.e., flush with the surface, and may be of similar color to the material so as to be unobtrusive.

C. Trim materials may be fastened in place by welding. The welding of trim materials is usually done off site. Finish materials are rarely welded in place (or connected by welding) on the site, but if they are, the welds must be accurate and present a good appearance. Usually materials such as ornamental or light ironwork are welded. The edges of the materials to be welded must be seamed with great accuracy. The sizes, lengths and locations of all welds must be in strict compliance with the specifications and drawings. All inflammable material must be removed from the area where welding operations are being carried out to avoid danger of fire.

D. Bonding includes the gluing of sheet or panel materials in place, final laying or pointing of facing brick or blockwork and similar materials. Whatever the material being used to bond or point thetrim, care must be taken to avoid splashing or oozing. All such splashes on material must be removed before the work is completed.

E. Coupling usually refers to the joining or fastening of lengths of pipes or shafts.

1. Couplings may be rigid (no movement) or flexible (movement possible).
2. The design of the coupling--whether rigid or flexible--for use in trim or finished work is important and is usually of a decorative (and often expensive) material.
3. Care must be taken to ensure that all members fastened by coupling are properly aligned so as to avoid failure of the coupling at a later date.

4. Examples of materials sometimes joined by coupling might include exposed plumbing, ornamental sculptures (which may be an integral part of the design), staircase supports, etc.
5. Clutches (couplings) which are like clips are sometimes used to fasten linear trim materials in place.

IV. Coating and Applying
  A. Before any coating or applying is carried out, the surfaces of materials to be included must be made ready, and any hardware such as electrical fittings, should be protected or removed. Coating is generally the application of any surface material in a relatively thin layer to a subsurface by brushing, spraying, rolling, troweling, sealing.
  B. Brushing is the rubbing or grazing of a surface with a quick motion so as to transfer the finish material from the brushing implement to the surface.
    1. When coating or applying by brushing, the subsurface must be dry and clean, and all cracks or holes filled so as to ensure a smooth, even surface when completed.
    2. When brushing a material onto a surface, the size of the brush and its texture will be determined by the area to be covered and the material being used to coat.
    3. Usually when brushing, more than one coat or application is necessary; the number of coats is usually specified.
    4. Care must be taken to ensure evenness of the finished surface and (in the case of paint) matching of color.
    5. Paint, tar, asphalt are among the materials which might be brushed on as a trim or wearing surface.
  C. Trim materials may be forced in the form of fine particles or liquid (mist) in a jet or vapor to disperse so as to cover a surface: spraying.
    1. Paint, cement render, plastics and many other surface or decorative materials may be sprayed on.
    2. Usually some form of cleaning and drying of the subsurface is necessary.
    3. The number of coats, i.e., the thickness of the finish, is usually specified.
  D. Trim material may be transferred from a cylindrical implement, which rotates, to a surface so as to coat that surface by rolling.
    1. Paint, tar, asphalt, plastic or fiberglass materials might be rolled on.
    2. The thickness of the finished work is usually specified.
    3. The size of the roller is usually determined by the area of surface to be coated and/or the manufacturer's instructions.

E. In troweling, a wood-handled, steel-bladed implement is used. In floating, the implement used is made entirely of wood. Both troweling and floating are finishing operations. They generally apply to the smoothing down of a previously applied surface.

1. Plaster faces are usually applied in several layers--a float is used to spread (apply) the plaster, and later, to smooth the surface.
2. Troweling cement mortar must be done with care as over-troweling brings the cement to the surface, which may lead to crazing when it dries out.
3. Stucco may be troweled after it has been ruled off and scoured.

F. Sealants may be liquids or semi-solids.

1. Sealants may be spread over an area, or be applied by use of a pressure gun, i.e., forced into a cavity or crack.
2. They may be used to close the pores of wood, e.g., the priming coat in painting, where size is often used, thus preventing absorption of oils by the wood.
3. Care must be taken to ensure that the sealant does not adversely affect the material it is sealing.
4. A semi-solid sealant like mastic is often used in making windows watertight, filling expansion joints, and for covering and filling the overlaps between similar and dissimilar materials.

V. All evidence of the construction work should now be taken away, the structure being made ready for use or occupancy, and fully operational. The final stage in finishing the structure is the removal of the workers' equipment which is no longer needed, and the clean up of building debris.

A. Heavy equipment is usually removed first, including scaffolds, mortar mixers, saws, and smaller tools.

B. Debris may consist of wood shavings, blocks of wood, or brick materials used in the construction process.

VI. Demobilizing Equipment

A. Equipment which has been fixed temporarily in position must be made portable again. Care must be taken in disassembling and transferring the equipment out from or off the site so as to prevent damage to the finished surfaces.

B. All facilities, such as scaffolds, ramps, stairs, or steps, temporary floors and the like, must be dismantled

C. Disassembled equipment and/or facilities must be transferred from the structure. These may be stored elsewhere on the site, or may be removed completely from the site. In some cases, it may be necessary to lower this equipment from the structure; therefore, care must be taken to avoid damage.

VII. Cleaning Up
  A. Once the equipment is out of way, clean up can begin.
  B. Scraping is done to remove paint or other material spots or stains. Care must be taken to avoid damage to the finished surface.
  C. Picking up then proceeds; any blocks of wood, loose nails, etc., must be picked up and taken from the structure.
  D. Sweeping is done so that shavings, dust, grit, etc., are brushed away.
  E. Any surfaces which have become dirty, e.g., windows, metal panels, etc., should be washed clean.
  F. Some floor and wall surfaces, and some fixtures, may be polished to remove surplus material, and to bring out the natural beauty of the material. Polishing includes waxing.

COMPLETING THE SITE

Reading Assignment
Day 114

I. The last major phase of construction is to make the total environment operational and complete. Completing the Site includes those activities which relate to providing access, building features, planting, demobilizing equipment, and removing debris. All processes and practices previously encountered may be exemplified in landscaping, with the additional practices relating to planting.
  A. Normally sites need to be landscaped to restore the property so as to make it operational and to present a good appearance.
  B. Any site has some degree of landscaping connected with it, the work being of major or minor importance, depending upon the purposes to be achieved, and the extent of operation.
  C. The site is the natural setting for the structure, whatever it may be (road, tunnel, tower, etc.). It is generally considered desirable that there be some degree of compatibility between the site and the structure.
  D. Whatever the structure, some form of access will always be necessary. Lighting, planting, signposting all form part of the landscaping process and are complementary to the main structure.

LANDSCAPING

Reading Assignment
Day 115

I. Landscaping includes more than just planting. Almost every structure requires that some form of access be provided to it, decorative features (which may also serve a useful purpose), outdoor lighting, planting, etc., which may be ancillary to the main structure. Nevertheless, these are complementary to it, and form a part of the landscape process.
   A. In the process of construction, the site--especially in the immediate vicinity of the structure--may be damaged or disturbed. It is the contractor's responsibility to see that such disturbance be restored and to eliminate any conditions which might prove dangerous or disruptive to the operation or occupancy of the structure.
   B. The site is the natural setting of the structure and generally specifications will be issued as to the final disposition of the site. This may call for additional work, such as the building of accesses, features, and earthworking.

BUILDING ACCESSES

Reading Assignment
Day 116

I. Finished connections may have to be made between the public and private road and pathways. Scenic walks, private or semi-private carriage ways all form part of the landscape work.
   A. Building and/or finishing accesses on site is a part of landscaping.
   B. Accesses include all paths, roads, walkways, steps, tunnels, underpasses.
   C. In the case of a highway or public road construction, the access or road itself will require landscaping.
   D. A road, or even a path, forms a very strong element in the landscape.

II. Surveying for Construction
   A. The location of the access must be found and marked before construction can begin.
   B. Temporary stakes or markers are usually set to mark the center line of the access and the corners or boundaries.
   C. The location of any underground utilities which may affect the work should also be determined and marked.
   D. The center line of the access or path is usually marked first, then the pavement edges are marked, and grades set.
   E. The operations involve the use of measuring, marking, and protecting, as were used in laying out the main structure.

III. Earthworking

A. Earthworking starts when the access or structure has been laid out (surveyed).

B. Earthworking may consist of cutting and filling, banking and/or spreading, as may be necessary to achieve the line and grade specified.

C. The practices of protecting existing utilities and structures and of stabilizing earthwork are employed as they were in building the main structure.

IV. Setting the Base

A. The base course or road bed is placed in position and compacted if necessary.

B. The base may consist of one, two, or even three courses. The first of these is usually a hardcore of broken stone. If the road is to be of concrete, the forms are made up and set in place and the reinforcement placed in position. The concrete is then mixed and placed in the forms, being made in bays, that is, sections, to prevent cracking due to expansion and contraction. The concrete is then allowed to cure, after which the forms are removed.

C. All of the practices described in Setting Foundations in the primary structure may be employed in this stage.

V. Installing Circulatory Systems

A. Service pipes, utility lines, etc., are frequently located under accesses. If this is the case, the pipes must be placed in position before the road is set.

B. Utility lines may frequently be located along the sides of access right-of-ways.

C. Provision must be made for utilities in setting and making formwork, and in placing the concrete or other surface materials.

VI. Finishing the Access

A. The road or pathway must be given a wearing surface and trimmed.

B. In building accesses, the finish surface may serve several functions at once. It may be decorative, and at the same time provide a hard, durable wearing surface.

1. Surfaces may be of concrete, asphalt, brick, or any other type of material depending upon the function it is expected to fulfill.

2. Concrete surfaces are placed in position, struck off, and textured as required. Asphalt surfaces will require rolling. In general, the practices used in surfacing will depend upon the surface material and the conditions laid down in the specification.

Reading Assignment
Page 116 (continued)

C. Accesses generally require some form of signposting, whether for a private driveway, or a interstate highway. Also, provision must be made for drainage, painting, lighting, etc. The practices used will depend upon the time required and the specifications, but, generally, will include many of the techniques listed in describing the building of the primary structure.

BUILDING FEATURES

Reading Assignment
Day 117

I. Plans may call for the building of features. These features need to be located, their foundations cleared and set, built or placed, and finished. Features may be functional, that is--serve a useful purpose, or be purely decorative, or both. Whatever the purpose of their inclusion in the work, they are generally complementary to the primary structure.
   A. Features may include such things as fountains, walls, shelters, sculptures, rockeries, etc.
   B. A survey must be carried out to determine the location of the features.
   C. The location determined, the earth is prepared as required to found the feature.
   D. The foundation or base of the feature is placed as required. The structure of the feature is then erected in place.
   E. Circulatory systems, as may be needed, are then installed.
   F. The features are then finished according to specifications.

SHAPING AND FINISHING EARTH

Reading Assignment
Day 118

I. This stage relates to the molding or contouring of earth to certain specifications, and later planting and/or surfacing as required. Shaping and finishing may be necessary to restore the parts of the site disturbed during the building of the primary structure, and to give the site a good appearance.
   A. The process of shaping the earth involves the layout of the earth (location of banks, etc.), earthmoving, the preparation of the surface, planting and surfacing.

B. The extent of the work--the number of men and machines-- which may be major or minor depends upon:
  1. the size of the site
  2. the nature of the primary structure
  3. the purpose such shaping and finishing is to serve.

C. Shaping and finishing the earth normally constitutes the major part of the landscape work.

II. Laying Out

A. The final disposition of the earth on the site surface is usually set forth in the specifications. In order to locate any banks, cuts, fills, etc., a survey involving the practices of measuring and marking is carried out. This is referred to as Laying Out.

III. Earthmoving

A. The earth is pushed or dug out in accordance with the layout. To do this, bulldozers, power shovels, rollers, and other earth-moving equipment may be used.

B. In banking, the earth is heaped up, and allowed to slump to its natural position, as may be called for by the layout.

C. Depressions may be filled in with earth taken from a "borrow" area which might be on or off the site.

IV. Preparing the Surface

A. When the rough outline of the layout has been achieved, the new elevations are prepared to receive their final finish.

B. Final grades are established and the earth spread or bulldozed to comply with the specifications.

C. The earth may be turned over or loosened to allow for seeding and/or sodding.

D. A layer of topsoil may be spread over the rough surface.

E. Chemicals or natural fertilizer may be introduced into the rough topsoil to assist in future growth of vegetation. This may be done by spraying, or spreading. Also the rough surface may be treated by compacting with rollers if the finish desired calls for the laying of foreign materials in layer form.

V. Planting and Surfacing

A. The shaped earth may be finished with a cover of vegetation, or by laying a surface material of permanent or temporary nature on top of the earth, e.g., gravel driveways, paved patios, etc. Planting may include digging holes for the placing of trees or plants, spreading seed (either mechanically or by hand), treating plants and sodded areas with fertilizers, and/or protecting plants by means of covers, stakes, etc., from attack by animals, insects, or weather.

Reading Assignment
Day 118 (continued)

B. In seeding, seed is distributed evenly over the surface to yield an even carpet of grass.
C. Large areas may be sodded. Sod is usually laid in sections and may have been saved from the clearing operation.
D. Trees, bushes, and plants require that a hole be dug for the roots, the plant placed, and the earth gently tamped around it.
E. In spreading, gravel may be distributed evenly over the surface.
F. Trees, lawns, plants, etc., may be treated by spraying with chemicals and fertilized.
G. Tree trunks may need to be wound and/or chemically treated to protect them against disease or insect attack and against extreme weather, accidental damage or vandalism.

REMOVING EQUIPMENT AND DEBRIS

Reading Assignment
Day 120

I. Contractor's equipment remaining on the site from before the landscaping process, and from the landscaping work itself, is now removed. Also included in this stage is removal of any debris.
   A. Equipment must be demobilized by loading and hauling, towing, or driving it from the site.
   B. Debris must be cleaned up. This is usually accomplished by picking up, raking, sweeping, burying, burning, or dumping.

REMOVING TEMPORARY PLANT AND FACILITIES

Reading Assignment
Day 121

I. Included in this stage are temporary facilities and temporary contractor's equipment which is no longer required.
   A. Facilities such as scaffolding, ramps, hoists, etc., must be disassembled and removed. In removing such facilities, consideration must be given to the order of removal; thus, shelters would be the last type of facility removed. Safety precautions are taken to avoid damage to the structure, and to protect personnel.
   B. Most temporary facilities are designed to be easily disassembled.
   C. The disassembled parts or components must be removed from the structure and the site.

II. Contractor's equipment--cranes, bulldozers, vibrators, hoists, manlifts, etc.--must be disassembled and hauled away from the site when no longer needed.

  A. Because of the size and complexity of some equipment, it may need to be dismantled and the components prepared for handling.
  B. Equipment and/or components are loaded or placed on or in self-propelled vehicles, or towed vehicles.
  C. The equipment, when loaded, must be moved from the site.

POST PROCESSING

Reading Assignment
Day 122

I. The purpose of post processing is to extend the function of efficiency and effectiveness of the structure and site (real estate). Post processing means to change the form of materials at a later date.

  A. Included in post processing are repair, installation, alteration and maintenance.
  B. The processes and practices used in post processing are identical to the processes used in production.

II. Repairing

  A. Damage, or wear and tear, to the structure and/or site is caused by aging, climatic conditions, air pollution, improper selection and treatment of materials used in building the structure, poor workmanship during construction, overloading of the structure, and improper use of the structure. Neglect can also be a factor. Parts most likely to be affected are those exposed to the weather--roof, walls, windows, pathways. Accesses exposed to heavy traffic or use are also affected--doors (entrances, exits), stairs, roads, tunnels (dirt accumulation). Neglect or failure to repair these parts will shorten the life of the structure and reduce its value and efficiency.
  B. The most common forms of damage or wear in a structure or to a site appear as rot due to dampness or lack of air circulation, cracking due to overloading of floors, roads, dams, paths, etc., or to excessive or restricted expansion and contraction of materials. Peeling is due to over-exposure to sunlight and the effects of time. Wear is due to abrasion. Overgrowth is due to neglect.
  C. Repairs are effected either by:
    1. replacing the damaged, aged, or worn out part
    2. coating and/or treating surfaces
    3. cutting away excessive growth.

Reading Assignment
Day 122 (continued)

D. These repairs may involve all or some of the practices used in building the original structure. The scale of the operations is reduced, thus, a wall may be cleaned and re-painted, or a section of a road torn out and replaced.

III. Altering
  A. Altering means to change the structural form of the structure from its original form and/or function, usually by addition or subtraction of some part in the structure. As conditions of life change, the need and function of the structure may change. The structure may expand, or decrease in size, in any direction. The practices in altering a structure are no different than the original practices involved in building the structure.

IV. Installing
  A. Installing is the addition of manufactured products to the structure which are not an integral part of the structure. Installation may be done by either the manufacturer of the product, or the building contractor, or both. Mechanical equipment, such as lighting, heating, ventilating, elevators, is installed, whereas windows, partitions, and built-in accommodations are constructed.

V. Maintaining
  A. The mechanical plant, utilities and services need periodic servicing and replacement of worn or faulty parts to ensure continued operation. The causes of damage are usually aging, carelessness, and overloading. Typical systems needing periodic maintenance are motors, shafts, elevators, escalators, air conditioning plants, heating plants, electrical and plumbing systems.
  B. All exposed surfaces to wear or weather need periodic maintenance. Thus, the need to polish floors, re-paint walls, clean windows is a recurring operation.

SUMMARY OF CHANGING THE FORM OF MATERIALS

Reading Assignment
Day 126

I. The purpose of this summary is to establish the common elements of construction as they apply to any structure. Included in this summary are worker control of measurement and shape, handling material, combining, separating, and changing form.

Reading Assignment
Day 126 (continued)

II. Production practices recur at all stages of production, no matter what the structure may be. A tunnel, for example, may have:
  A. provision for temporary access and protection
  B. roads and walkways
  C. temporary shelters
  D. temporary utilities
  E. obstacles to be reduced and extracted
  F. materials to be transferred and disposed of
  G. surveying for construction
  H. mobilization of equipment
  I. earthmoving
  J. protection of existing utilities and structures
  K. shaping and stabilizing of earthworks
  L. the making and placing of forms
  M. the setting of reinforcement
  N. preparation of foundation material
  O. the handling, bonding, and curing of foundation material
  P. removal of forms
  Q. foundation finishing
  R. preparation of major structural elements
  S. fabrication of components
  T. handling of components
  U. treating
  V. removal of forms
  W. finishing
  X. the installation of permanent utilities and mechanical plant
  Y. the provision for temporary equipment
  Z. the preparation of subsurfaces
  AA. trimming
  BB. the removal of equipment and debris
  CC. the shaping and finishing of earth
  DD. the removal of temporary plant and facilities

WORKER CONTROL AND MATERIAL HANDLING

Reading Assignment
Day 127

I. Man does not change the shape of material without first determining the extent, method, and scope of change.
  A. Measuring and marking are worker controls to determine dimensions or proportions.
  B. Laying out is the act of giving the desired outline to the material.
  C. Positioning means to give advantage of one position over another by adjusting or aligning.

Reading Assignment
Day 127 (continued)

II. Material handling means to move materials from one place to another for the purpose of changing its location. Material handling is a continual activity in the process of changing the material form. Practices found in all stages of production may be summarized under one of the following categories:
   A. Protecting
   B. Generating, Compressing, Pumping
   C. Fluidized transport of solids
   D. Flow transport of solids and liquids
   E. Loading
   F. Unloading
   G. Attaching
   H. Carrying
   I. Hoisting
   J. Lowering
   K. Releasing

SEPARATING, COMBINING, FORMING

Reading Assignment
Day 128

I. All practices in changing the form of materials may be found under one of the following categories.

II. Separating
   A. Classifying
      1. Screening
      2. Sedimenting
      3. Drying
      4. Crushing
      5. Milling
   B. Material Removing
      1. Spalling
      2. Scaling
      3. Breaking
      4. Digging
      5. Scraping
      6. Grubbing
      7. Chopping
      8. Chaining
      9. Burning
      10. Planing
      11. Drilling
      12. Sawing
      13. Shearing
      14. Abrading
      15. Etching

- III. Combining
  - A. Mixing
    - 1. Blending
    - 2. Kneading
    - 3. Impregnating
  - B. Coating
    - 1. Spraying
    - 2. Brushing
    - 3. Rolling
    - 4. Dipping
    - 5. Sodding
    - 6. Spreading
  - C. Assembling
    - 1. Fastening
      - a. Pinning
      - b. Hooking
      - c. Clamping
      - d. Tying
      - e. Joining
      - f. Welding
      - g. Soldering
    - 2. Bonding
      - a. Gluing
      - b. Cementing

- IV. Forming
  - A. Working
    - 1. Hammering
    - 2. Plowing
    - 3. Consolidating
    - 4. Bending
    - 5. Molding
    - 6. Casting
    - 7. Striking Off
  - B. Displacing
    - 1. Scarifying
    - 2. Ripping
    - 3. Bulldozing
    - 4. Disassembling
    - 5. Wrecking
  - C. Thermal Conditioning
    - 1. Curing
    - 2. Heat Treating
    - 3. Melting
    - 4. Chilling

UNIT IV

WORKING IN CONSTRUCTION

INTRODUCTION TO WORKING IN INDUSTRY

Reading Assignment
Day 136

I. Man is the Most Critical Resource in Industry.
  A. The conditions under which industrial employees work, and the wages they receive, shape their lives to a large extent, but we know little about the world of industrial work.
    1. There are more than twenty million industrial employees (more than 1/4 of the labor force).
    2. They earn a large segment of the national income.
  B. In our way of life, individual men have certain inalienable rights.
  C. Workers control materials.
  D. Human problems are more difficult to solve, and are more common than problems with materials.
    1. These problems can be solved best with efficient personnel practices which are important to study because they ultimately affect everyone.
    2. Industrial practices which affect employees are not well known because they are poorly organized and little studied.
    3. Even a common name for the collective knowledge about these practices is not generally accepted.
      a. Some common names are "personnel relations," "personnel practices."
      b. There is need for a suitable name and definition.

II. The Industrial Employee
  A. Manufacturing and contract construction categories include common classes of industrial employees.
    1. There are two basic kinds of industrial employees:
      a. those who use industrial knowledge
      b. those in industry who use other knowledge
    2. The number of employees, and diversification of same, is large.
    3. There are a number of common sources of employment data.
  B. There are some others who may be considered to be industrial employees, such as:
    1. stockholders and other investors
    2. those who provide other inputs to the industrial system.
  C. Trends in Industrial Employment can be divided into:
    1. past
    2. present
    3. predicted.

III. Practices which Affect Human Behavior in Industry are developing.
   A. These practices are not well classified.
   B. These practices are less precise than those which affect materials.
   C. One way of classifying the practices which affect humans is to group them according to the sequence in which the worker encounters them from his first contact through his last, i.e.:
      1. hiring practices
      2. training practices
      3. working practices
      4. advancing practices
      5. retiring practices
   D. The sequence or parts of it may be repeated and are not encountered in every employment experience.
   E. Different classes of employees may encounter different practices; thus, there is not a single set for any of the classes of practices.

IV. Construction and manufacturing personnel practices are similar, but have many differences.
   A. Basically, personnel in both are hired, trained, worked, advanced, and retired.
   B. Construction employees are often outdoors; manufacturing workers seldom are, with resultant differing problems.
      1. Different food services
      2. Different protection requirements
   C. Manufacturing employees and employers are more permanent, geographically.
      1. Single construction employer less able to invest in training
      2. Size of manufacturing work force more stable

HIRING THE RIGHT MAN FOR THE RIGHT JOB IN CONSTRUCTION

Reading Assignment
Day 137

I. The First Contact with Employees
   A. Importance of first impressions
   B. More thorough investigation required by both employer and employee
      1. Appreciate each other's problems.
      2. Know the practices used in hiring

Reading Assignment
Day 137 (continued)

- II. Hiring is important to the applicant and to the employer.
  - A. The employer's concerns are:
    - 1. profit relates directly to personnel
    - 2. reducing worker mobility reduces cost
  - B. The employee's concerns are:
    - 1. interests
    - 2. satisfaction

- III. Inherent conflict of interests requires both parties to recognize each other's interests.
  - A. Owners want more profit (income)
  - B. Workers want more profit (income)
  - C. Each is affected by the other

- IV. Hiring involves several major concept classes.
  - A. Recruiting
  - B. Selecting
  - C. Inducting

RECRUITING THE "IN CROWD"

Reading Assignment
Day 138

- I. The First Step in Hiring
  - A. Based upon need for additional employees
  - B. Involves many techniques and people

- II. Employee Types
  - A. Professional
  - B. White Collar
  - C. Blue Collar

- III. Prime Sources of Employees
  - A. Walk-ins
  - B. Friends
  - C. Employment agencies
  - D. Union halls
  - E. Newspaper advertising
  - F. School placement office

- IV. Entrance to, and Advancement within, the Various Source Organizations
  - A. Direct application
  - B. Apprenticing
  - C. Formal education and/or training

Reading Assignment
Day 138 (continued)

V. Process by which Management informs Prospective Employees of its Manpower Needs
   A. Public media announcements
   B. Contact employment agencies
   C. Personal contacts

SELECTING ROUND PEGS FOR ROUND HOLES

Reading Assignment
Day 139

I. The Second Step in Hiring
   A. Misfits are costly to both parties
   B. Much error involved even at best
   C. Efficient practices can help
   D. Involves description of the worker and the job requirements, and attempting to match them
   E. Similarity between school and industrial records, and their development and use

II. Job Requirements
   A. Personnel
   B. Skill
   C. Interpersonal aspects

III. Means of Gathering Personnel Data
   A. Application forms
   B. Testing
   C. Interviewing
   D. Obtaining and checking references
   E. Types of data sought
      1. Character
      2. Sex
      3. Personality traits
      4. Physical qualifications
      5. Particular experience
      6. Education
      7. Age (top and bottom)
      8. General experience
      9. Citizenship
      10. Military status
      11. Family status
      12. Residence
      13. Political affiliation

Reading Assignment
Day 139

IV. Practices employed in Matching Worker Qualifications and Job Requirements
  A. Relating applicant data profile with that of presently successful employees doing similar work
  B. Making personal value judgments
  C. Electro-mechanical selection

V. Means of, and reasons for, both sides reporting employment progress decisions to the other party
  A. Formal and informal means
  B. Public relations

FITTING THE PEGS INTO THE HOLES

Reading Assignment
Day 140

I. The Third Step in Hiring
  A. Compare induction of new student and new worker.
  B. Compare similar effects of adequate vs. inadequate orientation.
    1. Personal
    2. Productivity

II. Common ways in which workers are apprised of their roles in the establishment.
  A. Written contact
  B. Oral agreement

III. Personnel Records
  A. Kinds of records
  B. Use of records
  C. Maintaining of records

IV. Orientation of workers to the work process and work environment
  A. Introduction
  B. Explanation
  C. Demonstration

KEEPING UP WITH PROGRESS

Reading Assignment
Day 142

- I. Importance of Industrial Training
  - A. Scope
  - B. Trends
  - C. Training important to both employer and employee.
    - 1. Aids employer in maintaining an up-to-date work force.
    - 2. Helps employee keep up-to-date, and to qualify for advancement.
  - D. Training may be of different types and degrees of formality, dependent upon the nature of the training and the trainee.

- II. Training Employees
  - A. Principal training types
    - 1. On-the-job
      - a. Apprenticing
      - b. Interning
      - c. Coaching
    - 2. Other training
      - a. Conducting conferences and workshops
      - b. Providing instructional material
      - c. Classroom instructing
      - d. Sending to outside programs
  - B. Education is part of the capital investment of the enterprise.
    - 1. May be public contribution
      - a. Secondary school
      - b. Vocational school or technical institute
    - 2. May be employer's or employee's responsibility (all types--see A)
  - C. There is an interrelationship between worker training and worker efficiency.
    - 1. New technology and/or advancement may require additional training.
      - a. Automation
      - b. Mechanization
      - c. Substitute materials
    - 2. Training techniques vary with training needs.
      - a. Specific job
      - b. Abilities and/or personal traits of trainee

THE SATISFIED EMPLOYEE IN THE EFFICIENT COMPANY

Reading Assignment
Day 144

- I. Importance of working conditions to the employee and the employer.
  - A. Morale, economic well-being, and physical welfare all affected by working conditions
  - B. Practices have evolved to regulate these conditions.
- II. Classes of practices affecting working conditions
  - A. Economic
  - B. Physical
  - C. Social
- III. Working conditions may be agreed to several ways
  - A. Negotiation
    - 1. Contracted agreements
    - 2. Non-contractual agreements
  - B. Mediation and arbitration
  - C. Factors outside of A and B

ECONOMIC REWARDS OF WORKING

Reading Assignment
Day 145

- I. Employee economic well-being is dependent upon total economic advantage.
  - A. Fringe benefits, plus wages, total the economic reward for work.
  - B. There are practices which determine these rewards.
- II. Wages and Salaries
  - A. Dependent upon many factors, e.g.,
    - 1. supply and demand
    - 2. geographic considerations
    - 3. work status
  - B. Sometimes formally set, sometimes informally
- III. Fringe Benefits
  - A. Dependent upon many factors, e.g.,
    - 1. supply and demand
    - 2. geographic considerations
    - 3. work status
  - B. Sometimes formally set, sometimes informally

Reading Assignment
Day 145 (continued)

IV. Personal Considerations
  A. Proximity to a particular job
  B. Geographic preference over direct economic gain
  C. Prestige advantage over economic gain
  D. Preference to work with friends

THE PHYSICAL WORKING ENVIRONMENT

Reading Assignment
Day 146

I. The importance of the Physical Surroundings to Productivity and Employee Satisfaction
  A. Men work better in some settings than in others.
  B. Morale, safety, and satisfaction relate to physical surroundings.

II. Safety and Health Equipment
  A. Progress in, and significance of, industrial safety
  B. Legal requirements affecting practices
  C. Formal and informal agreements on practices
    1. Heating and cooling and ventilating
    2. Lighting
    3. Coloring
    4. Posturing
    5. Protecting
    6. Meeting other personal needs

III. General Housekeeping
  A. Progress in housekeeping standards
  B. Formal and informal agreements on practices

IV. Personal Considerations
  A. Some prefer greater risk at higher pay.
  B. Some prefer added economic reward to physical comfort.

THE SOCIAL WORKING ENVIRONMENT

Reading Assignment
Day 147

- I. The Importance of the Social Environment
  - A. The evolution of concern for the social environment
  - B. Morale and satisfaction relate to the social environment.
  - C. Practices have evolved which affect the social environment.

- II. Providing the Social Environment
  - A. Recreational activities
  - B. Social programs
  - C. Communications channels
  - D. Acting on surveys
  - E. Structuring the work group
  - F. Disciplining
  - G. Merit Rating
  - H. Service Awards

- III. Personal Considerations
  - A. Differing desires for socialization
  - B. Varying effects of reward and reprimand according to individual differences

CAREER PATTERNS IN CONSTRUCTION

Reading Assignment
Day 150

- I. Advancement practices are important in securing and maintaining employment and/or an effective work force.
  - A. Career progression is not always positive.
  - B. Practices have evolved that affect career progression.
  - C. Employment status has many economic and social ramifications.

- II. Kinds and Nature of Advancement Practices
  - A. Promoting
    - 1. Reassigning upward
    - 2. Reclassifying upward
  - B. Demoting
    - 1. Reassigning downward
    - 2. Reclassifying downward
  - C. Discharging
    - 1. Separating
    - 2. Relocating
    - 3. Laying off
  - D. Retiring

Reading Assignment
Day 150 (continued)

III. Significance of Worker Advancement in His Job or Profession
    A. Job satisfaction
    B. Education
    C. Social structure

IV. Advancement vs. Interpersonal Traits
    A. Effects of advancement
        1. Social
        2. Psychological
        3. Economic
    B. Training vs. advancement
        1. Skills
        2. Personal traits

UNIT V

COMMUNITY DEVELOPMENT

INTRODUCTION TO COMMUNITY DEVELOPMENT

Reading Assignment
Day 156

1. Construction is an element of economic activity, a series of practices through which the economic and social needs of people are provided for in the construction of objects fixed to a site. Almost everything in a community is constructed. Houses, streets, stores, sewers, schools, playgrounds, and even parks, are constructed.

2. A community is an economic and social system through which the needs of its people are met. Objects are constructed, resulting in the physical development of the community, in order to fulfill the community's social and economic purposes. Every object proposed to be built in a community must fulfill a social or an economic need of its people or it will not be constructed and maintained.

3. To fulfill its community economic and social purposes, each constructed object must be: (a) needed, (b) well located in relation to other objects to assure that it efficiently provides its service, and (c) economically located to assure that its cost is not greater than the value of its services.

4. Where each of these three conditions do not exist, the object will not be constructed, or, if it is constructed, it will be permitted to deteriorate. Many objects constructed in a community meet these conditions at the time of their construction, but fail to meet them at a later date due to community change. Construction objects, being permanently fixed to a location and of long-term durability and utility, therefore often become economically deteriorated before they physically deteriorate or lose their utility, resulting in great economic loss to individual citizens and to the community as a whole. Such losses can be minimized by planned community development. Through planned community development, efforts can be extended toward the realization of an economically sound, functionally efficient, personally satisfying community.

5. Communities develop in response to a need that requires construction of an object that creates employment. These primary community construction objects require service construction: the provision of transportation and utilities. Employment at a primary construction object creates manpower needs which, in turn, create needs for housing. Housing creates needs for road access to the employment location, educational facilities for the residents' children and local shopping facilities. Employment increases result in demand for high density housing, recreation and central business facilities.

6. The fulfillment of these needs requires the construction of industrial plants, sewer and water plants, underground piping systems, single-family houses, roads, schools, stores, apartment houses, parks, playgrounds, office buildings, department stores and all other components of a community. Each constructed object in a community is actually supported by employment at the primary community construction object, is constructed to fill a need created by prior construction, and creates needs for additional construction.

7. In order to be constructed and maintained, each object in a community must meet three sets of construction factors: need factors, function factors, and land factors.

Need Factors:
- a. the general type of object must be needed.
- b. the specific qualities of the object must be needed.
- c. the number of objects to be provided must be needed.

Function Factors:
- a. the object must be located in such a manner as to efficiently provide its service to other objects.
- b. the object must be located in such a manner as to efficiently provide for its own needs for service from other objects.

Land Factors:

a. the object must be located on land the soil quality of which permits economic development.

b. the object must be located on land the slope of which permits economic development.

c. the object must be located on land the price of which permits economic development.

Each of these conditions must be met by an object if it is to fulfill its role as a part of the community system. If these conditions are not met, the object will usually not be built. If the object is built and these conditions are not met, the object will not be maintained, and it will be permitted to deteriorate.

8. The location of communities is not an accident. Communities develop at specific locations because a need can be best fulfilled at that location. The types of need that cause communities to develop include:

a. need for development of a natural resource
b. need for a change in transportation
c. need for the economic processing of materials
d. need for defense
e. need for political action

3

9. Communities based on the development of a natural resource develop at the location of the resource. Boulder City's location in southern Nevada is determined by the potential for electric power generation in the gorge of the Colorado River, a potential fulfilled through the construction of Hoover Dam. Similarly, the location of Page, a community in northern Arizona, is based on the potential for electric generation in the gorge of the Colorado River at that location, a potential being fulfilled through construction of the Glen Canyon Dam. Butte, in western Montana, is located on the basis of a potential for copper mining fulfilled through construction of the Anaconda Copper Company's mining complex. Communities based on natural resource development might be based on mining, lumbering, development of hydroelectric power, oil extraction, or any other human use of a natural condition that generates employment.

10. Communities based on the need for a change in transportation develop at the intersection of transportation routes. Movement of goods from one means of transportation to another, or from one route to another, requires handling and the storage of freight, and servicing of both the equipment used in transportation and the manpower required to operate the transportation devices. The location of New York City is determined by the

intersection of land and river transportation routes with a great port for ocean shipping, requiring constructions of wharves, warehouses, railroad yards, ship repair yards and docks, food and lodging facilities for transportation workers and travelers, and many other facilities directly related to transportation. Similarly, St. Louis is located at the intersection of many transportation routes, as is Chicago.

11. Breezewood, in southern Pennsylvania, is located on the basis of the intersection of two major highway routes, causing the construction of many motels, restaurants and gasoline stations to service the motorists and their vehicles. Many communities in the Midwest are located at the intersections of road and railroad routes, resulting in the construction of great silos for storage of grain brought by road to the railroad depot. Communities based on a change in transportation might be based on the intersection of railroads, river routes, highways or any combination of travel facilities that results in construction of facilities requiring employment.

12. Communities based on the economic processing of materials develop at locations where the costs of raw materials, power, labor and transportation are so related as to result in a maximum profit from production. In the early nineteenth century, most of the population of the United States lived

along the Northeastern seaboard, and raw materials used in textile production came by ship from the Southern states. Because of this, a production facility for the manufacture of textiles was required to be near a seaport on the Northeastern seaboard in order to receive raw materials, and incur only low transportation costs in moving the finished products to the people who would be using them. At this time, New England had a large labor force, as textile production had been going on for years in home industries, and power from falling water was the primary industrial power source because electricity had not yet been harnessed. The result of all of these considerations was construction of a vast textile mill at the falls of the Merrimac River, a short distance from Boston, that caused the development of the city of Lowell, Massachusetts.

13. The location of most twentieth century communities that depend for their support on an industrial production facility generating employment is determined on the same basis: the balancing of raw materials, power, labor, and transportation costs.

14. Many communities have developed because of defense needs. Presidios (military establishments of the Spanish Empire) were developed at militarily important points in the

Empire. A presidio was built at the mouth of a great bay on the West coast of what is now the United States--the only access to a large network of inland waterways. By controlling the entrance to the bay with artillery at the presidio, the Spaniards were able to control a vast area of land that they hoped to colonize. This presidio was the Presidio de San Francisco, and the great city of San Francisco ultimately developed from this early provision for defense.

15. In the twentieth century, a number of communities have come into being because of the need for construction of military training bases, air bases, radar stations, missile stations and supply depots at locations selected to assure a complete defense network protecting our country.

16. Communities may also arise from political needs. Immediately after our nation's Revolutionary War, many states attempted to persuade Congress to select communities in their states for the location of the permanent Capitol of the new nation. The Southern states wanted the Capitol to be in the South, the Northern states wanted it to be in the North. The population and existing states at that time were located between the Appalachian Mountains and the Atlantic Ocean. As a result of political bargaining, Congress selected a site on the Potomac River, near the geographic center of the

United States as it existed at that time. The city of Washington, D. C., came into being at that site with the construction of buildings to house the Federal Government's activities. In this century, the Brazilian Government constructed a new Capitol city for Brazil, Brasilia, at a site in the interior of that country.

17. Many communities located on national boundaries have developed because of the political need for customs control: the control of people and goods flowing across national borders. Such communities develop from the manpower needs generated by the construction of customs stations.

18. Most communities do not develop on the basis of just one need for resource development, change in transportation, economic processing of materials, defense or political action, but on a combination of these needs that mutually support community growth through the construction of objects, requiring employment, that are essential to the fulfillment of these needs.

19. In all of the previous examples, an object was required to be constructed before the need could be fifilled: at Boulder City a dam was required; at Butte, mine heads, shafts and other mining facilities; at New York City, wharves

and warehouses and many other construction objects were needed; at Breezewood, Pennsylvania, the construction of highways was essential; at Lowell, Massachusetts, a textile plant was needed; at San Francisco, the presidio had to be built, and at Washington, D. C., government office buildings were required.

20. The construction required for the direct fulfillment of community-generating needs, the primary community construction, causes communities to develop if the constructed facility requires manpower for its operation. Employment at the primary community construction object is the essential basis for all further community development. Every other object constructed in the community is built either to directly serve the primary construction object through provision of utility or access services, or to fulfill the economic and social needs of people attracted to the community because of employment opportunities created by the primary community construction object.

21. Primary construction objects, as with all objects constructed in a community, must meet the requirements of need, function, and land factors if they are to be built and maintained. In order for Hoover Dam to be built, it was necessary that the general type of object, a dam with power generation facilities, be needed. If there was no need for power, the dam would not have been built. The specific quality

of the object also had to be needed. If there was not a demand for a dam with the electric power generative capacity of Hoover Dam, it would not have been built. The number of objects must also be needed. If two Hoover Dams had been proposed, but only one needed, only one would have been built. In addition to these factors of need, the dam had to meet functional factors. If the dam had been located in such a position as to make power transmission to users impossible or extremely expensive in contrast to other locations, the dam would not have efficiently provided its service and would not have been built. And if the dam had been so located that it was impossible or extremely expensive for repair and supply trucks to get to the dam, it would not have efficiently provided for its own needs and would not have been built.

22. But meeting the factors of need and function were not enough. The dam also had to meet land factors. If the dam had been located on soft clay, it would not have been built as it would not have been located on soils permitting economic development. The great weight of the dam, and the pressure of the water it holds back, require hard soils such as those that exist in the Colorado River gorge. And if the site had not been in a gorge, but rather on a flat plain, the dam would not have been built as the ground slope would not

have permitted the dam to contain its water economically. And had the dam been located in downtown New York City, it could not have been built, as the land price would have been too high for economic development.

23. These general factors of need, function, and land apply to every object constructed in a community. For example, industrial plants to be constructed to fulfill economic processing of materials needs must meet the following requirements if they are to be built and maintained.

Need Factors: a. the type of industrial plant must be needed: automobile factories would not be constructed if aircraft engine plants are the facilities needed.

b. the specific qualities of the plants must be needed: factories built to produce two propeller aircraft engines a day would not be constructed if factories producing one hundred jet engines for aircraft are needed.

Need Factors: (continued)

c. the number of plants must be needed: twenty jet engine plants would not be built if only one was needed.

Function Factors:

a. the plants must be located to efficiently provide their service: aircraft engine plants would not be built 2000 miles from aircraft assembly plants if sites for the plants were available closer to the users of the engines.

b. the plants must be located to efficiently provide for their own needs: industrial plants require water, power, sewage disposal, transportation for raw materials and manpower. A plant would not be built when these could not be obtained, or when such obtainment is more expensive than at comparable alternative locations.

Land Factors:

a. most large industrial plants have heavy equipment that requires firm soils, and often hard soils, for their support.

Land Factors: (continued)

b. most large industrial plants are one-story structures requiring flat or nearly flat ground slope for economic construction.

c. most large industrial plants require large areas of ground of relatively low price: a thirty acre, one-story industrial plant would not be built at Times Square in New York City, even though that location met all other conditions, because the land price would be too high.

24. If an industrial plant meets each of these factors, it will be built. When the fulfillment of a need causes the construction of a primary construction object (such as an industrial plant) that meets its factors of need, function, and land, resulting in employment, a community develops.

Illustrations:

1. Air photo of large city
2. Photo of houses under construction
3. Photo of new sewer being laid in existing street
4. Photo of playground under construction
5. Photo of deteriorated houses
6. Photo of a planned community
7. Air photo of large industrial plant

Reading Assignment
Day 156 (continued)

8. Ground photo of mass of workers leaving industrial plant.
9. Montage photo showing:
    a. highway leading to factory
    b. children in school
    c. women shopping
    d. high density apartments
    e. children in playground
    f. central business area
10. Air photo of Boulder City, showing city and dam
11. Air photo of Butte, showing city and mining complex
12. Air photo of New York City docks
13. Diagram of rail lines and highways at St. Louis
14. Air photo of Breezewood
15. Air photo of grain silo community
16. View of Lowell, Massachusetts, textile mills (19th century)
17. View of Presidio de San Francisco
18. Map showing location of Washington, D. C.
19. Air photo of Hoover Dam, showing surrounding wasteland and hard rock gorge
20. Air photo of large industrial plant with river, railroad and highway, on flat hard land, surrounded by a community

SERVICE CONSTRUCTION

Reading Assignment
Day 157

1. Primary community construction objects create the need for service construction. The operation of most primary construction objects requires transportation service to and from their sites, as well as water, sewer, gas, electric and telephone services. If these services do not exist at the site before the primary construction object is built, they must be provided before the facility can be used.

2. Service construction often results in the building of roads, railroads, docks, aircraft land strips and pipelines to provide transportation services, and water treatment plants, water pressure towers, sewage treatment plants, underground water, sewer and gas piping systems, and electric and telephone lines, either above or under the ground, to provide utility services.

3. Most primary construction objects require roads for construction vehicles, supply trucks and worker access. Roads are generally built on flat or sloped land, as trucks and cars have difficulty climbing steep hills, and on firm or hard soils in order to provide support for heavy trucking. Roads are usually located to provide the shortest economical distance between the points being connected by road service.

4. Railroad service is often the most economical transportation method where large amounts of heavy freight must be moved. Railroads are usually built on flat land, as railroad engines have difficulty pulling heavy laods up slopes, and on hard soils wherever possible because of the heavy weight of the engines and their freight load. As with roads, railroads are located to provide the shortest economical freight hauling distances between points needing railroad service.

5. Where a large amount of heavy freight must be moved, a nearby river is deep enough and wide enough to be used for barge shipping, and the goods must be moved to another point along the river, barge shipping is often the most economical means of transportation. Barge shipping requires the construction of docks at the riverside for the loading and unloading of freight. The construction of docks usually requires road or railroad access to the dock, flat or sloped land at the riverside, and firm or hard soils to support the weight of the dock, the freight being loaded, and the equipment required by the loading operation.

6. Transportation by airplane is often provided when the primary construction object produces goods of very high value but very light weight, or when it is important that transportation time be at a minimum. The construction of aircraft

landing strips requires a large area of low priced, flat ground, with firm or hard soils, close to the primary construction object.

7. Many materials can be transported most economically by pipeline. Liquids, such as oil and gasoline, are often transported this way, as are natural gas for heating and some solids. In some areas, fine coal is carried through a pipeline, suspended in water, and then dried for use as fuel at its destination. Pipelines generally run underground following the shortest route between points needing pipeline service. Most pipelines operate under pressure, permitting their contents to flow up-hill as well as down-hill, which requires the construction of pumping stations along their routes.

8. In addition to transporation services, most primary construction objects also require gas, electric, telephone, water and sewer utility services that result in additional community construction. Gas service, electric service and telephone service are generally available in most areas, simply requiring the construction of additional lengths of underground gas pipe, and additional pole facilities or underground cables for electric and telephone lines, to extend the existing utility systems to service the new primary construction object.

9. Water utility construction consists of three elements: (a) a water treatment plant, (b) a water pressure tower, and (c) an underground water distribution piping system.

10. Water supply is obtained from rivers, reservoirs or wells. When a large river with a constant flow of water exists near the site of a primary construction object, it will generally be used as a water source. If the river flow is not constant, if the river dries up or greatly reduces its flow from time to time, a dam will usually be built that holds back the water to assure a continuous supply, even during dry periods, creating a reservoir. Where a nearby river does not exist, where the river water is too impure for use, or where a reservoir cannot collect enough water to assure a continuous supply, wells will be drilled into the earth and water will be pumped up from underground sources.

11. Water is brought in pipes from the water intake at the river, a reservoir, or from wells, to the water treatment plant. Here the water is filtered and chemicals are added to it to make it safe for human use.

12. After the water is treated at the treatment plant, it is pumped up into an elevated tank called a water pressure tower. This tank must be higher than the highest site to be served with water in order to create the pressure that permits

the water to flow uphill as well as downhill to the sites needing water service. In some cases, a water pressure tower is not needed, and water is distributed to users directly from the treatment plant. This is the case where the water source itself is higher than the highest site to be served and additional pressure is not needed. But where this is not the case, a water pressure tower must be provided.

13. Water leaves the pressure tower in a large underground pipe that carries the water to a branch-like system of smaller and smaller pipes that bring the water to the sites where it is used. The pipe leaving the pressure tower must carry all of the water used in the area. Because of this, it is the largest pipe in the system. As other pipes branch off from this large pipe, carrying their water to users, the demand on the main pipe decreases because it does not have to carry as much water as when it left the pressure tower and the pipe becomes smaller and smaller as more branches drain off water from the main pipe. This results in a tree-like system of pipes--with the large pipe leaving the pressure tower as its trunk, and the small pipes delivering their water to individual sites as its smallest branches. The main pipe is often called the "water trunk", and the small pipes are called "branch lines".

14. The water treatment plant and water pressure tower, being constructed objects, must meet the conditions of need, function and land if they are to be built and maintained. The general type of facility must be needed. In rare cases, water brought directly from supply sources is so pure as to require no treatment whatsoever. When this is the case, a treatment plant is not needed, and it will not be built. When the water supply source is higher than the highest site to be served, a water pressure tower is not needed, and will not be built.

15. The specific qualities of the objects must be needed. A treatment plant with a capacity for treating 3000 units of water each day will generally not be built if only 1000 units of water per day are required. Similarly, a water pressure tower with a capacity for holding 3000 units of water per day will not be built if the treatment plant capacity, and demand, is only 1000 water units per day. A pressure tower 150 high will not be built if a tower 100 feet high is all that is needed. The number of objects must also be needed: three treatment plants and three water towers will not be built if only one is needed.

16. The water treatment plant and pressure tower must be located to efficiently provide their services. They

generally must be built upstream from users to prevent pollution of the water intake; if river or reservoir sources are used, preferably on high ground to reduce the height of pressure tower needed, and near the water source to reduce the costs of piping and pumping water from the source to the treatment plant and pressure tower. These facilities must also be located near the sites they are to serve to reduce the costs of piping the water from the plant and tower to the users. They must also be located to efficiently provide for their own needs. Both the water treatment plant and the water pressure tower require road access for supply, maintenance, and repair vehicles.

17. The soils upon which the water treatment plant and pressure tower are to be built should be hard, in order to safely carry the great weight of the water tower and equipment. The slope of the site of these facilities should be flat or moderately sloped, not steep, to permit economical construction and operation. The land price of the site of the treatment plant and tower should be as low as possible to reduce the total cost of the water utility system.

18. The underground pipes that distribute water to users are also constructed objects. If water is not needed at a particular site, a pipe will not be constructed to the

site. A pipe large enough to carry 500 units of water per day will not be built if only 100 units of water are needed by the users the pipe serves. And thirty lengths of pipe will not be provided if only twenty lengths are needed to provide water service to a site.

19. Water pipes must be located to efficiently provide their service. Rather than creating hundreds of small pipes running from users directly to the water pressure tank, the water demand is collected into trunks that are far less expensive. Water pipes are generally placed underground, along sides of streets, providing water service to the sites that gain their access from the streets. Water pipes also require their own service. Location of water pipes along street sites permits access to the pipe locations by service and repair trucks.

20. Trunk water pipes should preferably be located in hard or firm soils in order to support their great weight. Land slope is not a factor in water pipe location, as the water is under pressure, and land price is not a factor, as the pipes are usually placed in property along roads that are already publicly-owned.

21. Sewer utility construction consists of two elements: (a) an underground sewage collection piping system, and (b) a sewage treatment plant. Water used at a site enters the sewer piping system and flows to the sewage treatment plant where solid wastes are dissolved, or settled out and removed, and the liquid waste is treated to make it pure enough to be discharged into a river.

22. The sewer piping system is a branch-like system, similar to the water piping system except that it operates in reverse. Waste water enters the system at the ends of its branches and is collected into a large sewer trunk before it enters the sewage treatment plant. Unlike the water system which is under pressure, the sewer system operates by gravity flow, and waste water flows by gravity from its source through the treatment plant to the place of its disposal in the river. Because of this, sewer lines cannot run uphill. Every pipe in the system must run downhill from the end of its smallest branch to the end of the piping system at the river.

23. Sewer pipes must be needed, or they will not be constructed. If a site does not need sewer service, a sewer pipe will not be provided. A 24 inch diameter sewer pipe capable of carrying 750 units of sewage will not be provided if only

an 8 inch diameter pipe, with a capacity of 80 units of sewage, is needed. Likewise, a mile of sewer pipe will not be constructed if the same site could be served by the construction of just 500 feet of piping.

24. Sewer pipes, like water pipes, are located underground next to streets, providing sewer service to the sites along the streets, but each pipe of the system from the smallest branch to the largest trunk must run downhill in order to provide its service of waste disposal. As with water pipes, location next to streets permits access by service and repair vehicles.

25. Sewer trunk pipes should be laid in firm or hard soils, and the slope of the ground at the location is most important as each pipe must flow downhill. Land price is not a factor in sewer pipe location as they are usually placed in publicly-owned land along street sides.

26. Sewage treatment plants, being constructed objects, must also meet the factors of need, function, and land if they are to be constructed. In virtually all cases when water is used for human consumption, a sewage treatment facility is needed. But the facility must be of the right size. A plant with a capacity for treating 1,000 units of sewage will not

be built if a capacity of treating 10,000 units is required. It would be too small, and three sewage treatment plants would not be built if only one was needed.

27. In order to efficiently provide its service, the sewage treatment plant must be at the lowest level of the area to be served, to permit all sewage to flow downhill to the plant. It is also necessary that the treatment plant be as close to the river used for disposal as possible to reduce the cost of the piping system needed to carry the treated sewage from the treatment plant to the river. It is essential that the plant be located downstream from the users served to preclude contamination of the river near developed properties. The plant should also be reasonably close to the users served to reduce the cost of the piping system needed to carry the waste they produce to the sewage treatment plant. As is the case with the water treatment plant, the sewage treatment plant requires road access for supply, maintenance, and repair vehicles.

28. The soil of the site upon which the sewage treatment plant is located must be firm or hard, in order to support the equipment, and the plant site should be flat for economical construction and operation. The land price of the site should be as low as possible in order to reduce the total cost of the utility system.

29. When a primary construction object has been provided with its necessary transportation and utility services through construction of the roads, railroads, docks, aircraft landing strips, pipelines, water treatment plants, water pressure towers, water and sewer piping systems, and sewage treatment plants needed for its operation, the object itself is complete and ready to be used.

Illustrations:

1. Photo of a road under construction
2. Photo of a railroad under construction
3. Photo of a dock being used for barge loading
4. Photo of an airstrip
5. Photo of a pipeline being laid
6. Photo of a water intake at a river
7. Photo of a dam and reservoir for water supply
8. Photo of water well-heads
9. Photo of water treatment plant and water towers
10. Photo of laying of a large water line
11. Photo of laying of a large sewer line
12. Photo of sewer treatment plant and outfall
13. Diagram showing need for pressure tower
14. Diagram of water and sewer "trees," interrelated with parts labeled

MANPOWER AND HOUSING

Reading Assignment
Day 158

1. Primary construction at a site does not always result in the building of a community. In order for a community to result, it is essential that the primary construction object requires manpower for its operation. Where the primary construction object requires manpower for employment at the facility, this manpower often consists of wage-earners who are the only support for their families. Because the average American family consists of about three and one-half (3½) people, the community population created directly by employment at the primary construction object will usually be about three and one-half times as large as the number employed. A production plant employing one hundred workers will directly result in a community population of about three-hundred and fifty (350) people: the one hundred workers, plus two-hundred and fifty members of their families.

2. But this population will require the services of builders, doctors, dentists, lawyers, and shopkeepers to provide them with the goods and services they need. These "service workers," although not directly employed at the production plant, are nevertheless indirectly employed by the plant because their wages are paid by workers who gain their income

from the plant. Each production worker employer at a primary construction object generally supports about one and one-half (1½) such service workers. The production plant employing one hundred workers would actually create about two hundred and fifty jobs: one hundred workers employed at the plant, and one hundred and fifty service jobs.

3. Each job at a primary construction object will generally create a "market," a demand or a need, for two and one-half housing units--one for the worker and his family, and one and one-half for the service workers he supports and their families. Since the average American family consists of about three and one-half people, these two and one-half housing untis will house an average of about eight and three-fourths people.

4. Each job at a primary production object will, therefore, generally support eight and three-fourths people and create a market for two and one-half housing units. The production plant employing one hundred workers will generally create a total of about two hundred and fifty jobs, and a market for about two hundred and fifty housing units providing homes for about eight hundred and seventy-five people.

5. The construction of housing must meet the construction factors of need. "Housing" would be required under the

condition discussed above, so the type of construction object needed is known. Two hundred and fifty housing units would be needed, so the number of objects needed is known. But the specific qualities of housing needed is not known.

6. The simple provision of two hundred and fifty housing units would not assure that the houses built would be sold, or that the community population created by the industrial plant would be adequately housed. The housing units built might be more expensive than the workers could afford, or it might be so inexpensive and small as to be considered inadequate by workers of high income.

7. Single-family housing units on large lots in newly developing areas are generally expensive housing units, as the land price, street development costs and utility development costs per housing unit are high. Large lot, single-family housing units are generally constructed with from one to three housing units to the acre, on sites of from 200' x 200' to 100' x 140'. Such low density housing (very few housing units to the acre) is often referred to as SF (1), single-family, one housing unit to the acre, or SF (3), single-family, three housing units to the acre. In general, no more of these expensive large-lot housing units will be sold than there are workers of high income.

8. Middle income single-family housing units in newly developing areas are generally constructed at a density of four to five housing units to the acre, on sites of from 90' x 100' to 80' x 100'. Such housing is often referred to as SF (4) and SF (5). In general, no more housing of this type is sold than there are workers of middle income.

9. Lower income single-family housing units in newly developing areas are generally constructed at a density of six to seven housing units per acre in order to reduce the land, street and utility costs per housing unit as much as possible. Such housing is built on sites of from 65' x 100' to 50' x 100', and is often referred to as SF (6) and SF (7). No more housing of this type is generally sold than there are workers of lower income.

10. Were it known that ten of the two-hundred and fifty jobs created by the industrial plant were to be of high income, that no housing of high income quality existed, and ten SF (3) housing units were proposed to be built, the specific qualities of housing needed would be known, and the proposed construction would be supported by need.

11. But the construction of these ten SF (3) units would also have to meet the construction factors of function and land.

Housing units of all types must be located on or near roads giving access to the primary employment location, and must be close to the employment location in order to result in low travel costs and short travel times, if they are to efficiently provide their service. Housing units also need this road access, as well as a location serviceable by utilities, water, sewer, gas, electric and telephone, if they are to efficiently provide for their own needs.

12. Land qualities greatly influence the location of housing. All housing requires firm or hard soil quality for good support. Soft soils result in settlement and cracking of even the lightest housing units. In general, medium and high density single-family housing, SF (4), SF (5), SF (6), and SF (7), cannot be built on ground with steep slopes because of the increased land cost of earthmoving, the difficulty of siting buildings and streets on steep hillsides and the additional costs of foundations for many structures on steep slopes. But low density, single-family housing, SF (1), SF (2), and SF (3), can usually be built on all ground slopes, even steep slopes, as the increased costs of building on a steep slope can be made up in the increased sales price of these expensive housing units, and the problems of siting buildings on steep slopes are reduced because of the number of buildings is reduced.

13. The sale price of housing units consists of three elements: (a) the developer's cost to construct the units and develop their sites, (b) the cost of the land the units occupy, and (c) the developer's overhead and profit. Any increase in land price reduces the amount available to the developer for profit, assuming that no reductions in construction costs or site development expenses can be made without reducing the sale price of the housing units. Where all other construction factors of need, function, and land are met by a number of sites being considered for housing development, all other things being equal, the site with the lowest land cost will be selected as it will result in a maximum profit.

14. Some sites have a land price that is so high that no single-family housing units can possible be built on them. This is the case where the land price equals, or is more than, the difference between the potential sale price of the housing units and the developer's cost to construct the single-family housing units and develop their sites. Under this condition, no money is avilable for overhead and profit, and single-family housing units will not be constructed.

15. Were an industrial plant to be constructed employing 450 workers, about 675 service jobs would be created, resulting in a total employment of 1,125 people, a market for

1,125 housing units, and a total population of about 3,938 people. If 10% of the total employment were high income workers, there would be a market for about 113 high income housing units. If no vacant high income housing were available in the community, 113 SF (3) housing units could be sold, provided:

a. the units were located on or near roads giving access to the employment location.

b. the site of the units is close to the employment location.

c. the site of the units is serviceable by utilities.

d. the soils on the site are firm or hard.

e. the ground at the site is flat or sloped, but not steep.

f. the land price of the site permits a significant profit from the construction of the housing units.

Illustrations:

1. Diagram of relationships between numbers of basic workers, service workers, total population, and housing units needed
2. Air photo of SF (1)
3. Air photo of SF (3)
4. Air photo of SF (5)
5. Air photo of SF (7)
6. Ground photo of well-designed SF (3)
7. Ground photo of well-designed SF (5)
8. Ground photo of well-designed SF (7)

Reading Assignment
Day 158 (continued)

9. Ground photo of SF (3) on hillside slope
10. Ground photo of steep slope
11. Ground photo of slope
12. Ground photo of flat ground
13. Ground photo of soft wet ground
14. Comparative drawing of site sizes, SF (1), SF (3), SF (5), SF (7)
15. Air photo of vacant site near downtown with land price too high for SF housing
16. Air photos of well-designed SF housing groups.

COMMUNITY FLOOD PROTECTION

Reading Assignment
Day 159

1. Floods are very destructive in terms of both the economic value of constructed products in the community that are destroyed or damaged, and the human misery they cause. During the ten year period between 1950 and 1960, more than 1,000 people died in the United States in floods that caused losses of more than four billion dollars ($4,000,000,000) in flood damages.

2. Flood plains, flat or slightly sloped areas at the sides of streams or rivers that are often covered by flood water, often become the location of employment construction, housing, and other constructed objects in the community. Why are objects constructed in these areas that are most likely to produce flood damage?

3. Flood plain areas, being generally flat, are usually the location of railroads and highways because construction of these facilities on flat ground is least expensive. The existence of these transportation facilities near a waterway, a source of water and a means of disposal, in an area of flat land makes flood plain sites attractive for the location of industrial plants. Most industries need road and railroad service, water for use and disposal, and generally flat ground.

4. Industries that locate in flood plains create a need for housing. This need is usually met near the plants, in the flood plain, in order to result in short transportation distances and minimum investment in roads and utilities. And the flatness of the ground results in low site development costs as little earthmoving is required, and places no restructions on the type of housing that can be developed.

5. The result of this process is the construction of many objects in the flood plain, around the employment object, that are in danger of damage from floods. But flood plain areas are not the only areas in danger of flooding. Areas far above the level of the flood plain may also be threatened by less frequent, but more severe, floods.

6. An area of ground may be covered with flood water today, and then not be flooded again for another ten years. Such a flood is a "ten year" flood, one that occurs an average of once every ten years. A ten year flood might occur twice this year, and then not occur again for twenty years. Most flood plain areas are areas flooded by ten year floods, or more frequent floods. But more severe floods might occur every twenty years. A "twenty year" flood, being more severe, will usually result in the flooding of more land than will a ten year flood, as there will be more flood water. And a "forty year" flood would be still more severe, but less frequent, flooding an even larger area.

7. The "year" of a flood indicates the probability of its occurrence, and the amount of flood water it will cause. The chance that a ten year flood will occur in any one year is four times as great as the chance that a forty year flood will occur. But when a forty year flood occurs, it will flood a much greater area than will the ten year flood.

8. The areas placed underwater by a flood are indicated by the level to which the flood water rises during the flood. A ten year flood might raise a river's level twenty feet above its normal level. If the normal level of the river is 500 feet above sea level, such a flood would flood all areas bordering the river that are below 520 feet above sea level. Such levels above sea level are indicated on maps by use of contour lines indicating equal intervals of distance above sea level (100', 200', 300', 400', 500', 600', etc.). A "forty year" flood might raise the river eighty-five feet above its normal level. If this were the case, all land bordering this river that is below a 585 foot contour would be flooded.

9. Construction in a community is protected from flood damage by one of two methods: either (a) construction is removed from floodable areas, or (b) flood water is removed from construction areas. When the first method is used, construction is not undertaken in floodable areas. To assure that nothing is built in these areas, communities purchase floodable ground

for "flood plain open space" or make payments to owners of such ground, purchasing the right to build on their property. The second method requires construction of either a dam or levees.

10. Dams store flood water upstream from the community in areas where no damage can occur, and release the flood water a little at a time to assure that the river or stream does not overflow its banks. Where levees are constructed for flood protection, the natural banks of the river are raised through construction of high earth walls that hold the flood water within the river bed, preventing it from flooding out onto the surrounding ground.

11. Regardless of the method, flood protection must be needed or it will not be provided. None of these methods would be used, no "flood plain open space" would be provided, no dams or levees would be built, if the area had no record of flooding whatsoever, or if the community was located so high above waterways as to be totally out of danger from even the most severe flood.

12. The specific qualities of the flood protection method must also be needed. High ground, well above the highest flood level, would not be purchased for "flood plain open space." A dam two hundred feet high would not be built if a dam over one hundred feet high would never be needed. A fifty foot

high levee would not be built if only a thirty foot levee was needed to protect the community from the most severe flood.

13. The number provided must also be needed. One hundred acres of flood plain open space would not be purchased if only fifty acres were ever flooded. Two dams would not be built if only one was needed. And five miles of levee would not be constructed if two miles of levee would protect the community from the most severe flood.

14. Flood protection devices must be located to efficiently provide its service to the community:

a. Flood plain open space must be located in such a manner as to prevent construction on those tracts of ground most likely to attract development. It is of little use to provide vast areas of outlying ground for flood plain open space, leaving areas near the river by roads, railroads, highways, and industrial plants open for development.

b. Dams must be located upstream from the community to be protected, far enough away so as not to occupy a lot of ground that will be needed in the future for community expansion.

c. Levees must be located at the river banks, as close to the natural banks as possible so that a minimum area of ground is within the levees and thus unprotected.

15. Flood protection devices must also be located to provide their own service requirements:

a. Flood plain open spaces need roads for access to permit their use for agriculture or community recreation.

b. Dams must be located where access roads can be built for construction, service and supply vehicles, and for access to the lakes they create so they can be used for recreation.

c. Levees need road access for construction, repair and emergency vehicles. Emergency trucks must be able to unload sandbags at the levee in the event of a break in the levee during a flood.

16. Land factors must also be considered when selecting a flood protection device. Soil quality, although not a factor in flood plain open space as no construction is undertaken, is important in the construction of dams and levees. Dams need hard soils to resist the force of the water they hold back. And levees generally need firm soils as soils that are too soft will wash out from under the levee, because of the pressure of the flood water, causing it to collapse. Land slope is usually not an important factor in open space protection or levee construction, but dams require steep valley hillsides to hold the water behind them and to reduce the width of the dam needed.

17. As in all construction, land price is a factor in flood protection. While land is cheap, at the early stages of community development, open space flood protection can be economically provided. But as development increases, land prices rise, often making open space the most expensive protection method. When large areas are developed in floodable areas, the high price of the remaining undeveloped properties and the great amount of existing development that would remain unprotected, usually require adoption of a flood protection device other than open space. Dam construction requires a large area of cheap upstream property, as the lake created by the dam will be quite large and the land it occupies, as well as the site of the dam itself, must be purchased. Levees occupy the least land of all the flood protection methods. They are often used where high land prices prevent the purchase of open space and inexpensive land is not available upstream for a dam, or where land slope or the soil upstream do not permit dam construction.

18. Dams and levees, and flood plain open speces, are parts of the community economic and social system. They are provided to create protection against future loss of life and property value caused by floods. Their provision is not accidental; they must meet the construction factors of need, function, and land, if they are to be proveded and maintained.

Illustrations:

1. Air photo of a flooded town
2. Photograph of a flood plain
3. Air photo of industry and housing in flood plain near a railroad, highway and river
4. Air photo of land bordering river, showing 10, 20, and 40 year flood levels
5. Same area shown on U.S.G.S. map with contours and flood levels marked
6. Air photo of construction kept out of flood plain.
7. Photo of dam and lake (ground level)
8. Photo of levee (ground level)
9. Land slope at dam - steep hillsides
10. Land slope at dam - gorge
11. Air photo of dam and downstream community
12. Air photo of levee-protected town

STREET CONSTRUCTION

Reading Assignment
Day 160

1. The building of primary construction objects and housing units for workers creates the need for construction of streets providing for movement from housing areas to places of employment.

2. There are three basic street types, each with its own specific qualities: (a) service streets are built to give access to sites next to the streets and carry little or no through traffic, cars using the street to move to and from other areas of the community. Service streets rarely have many cars on them. They are built with two lanes for the movement of cars, one in each direction. In most cases, a service street can not safely have more than 600 cars an hour moving down it in either direction; (b) collector streets not only provide access to sites at the sides of the roads, but also collect the cars from service streets onto one larger street. These collector streets are often four lane streets, with two lanes for the movement of cars in each direction. Four lane collector streets usually cannot safely have more than 1200 cars an hour moving down them in either direction; (c) arterial streets are built to carry through traffic quickly from one area of the community to another. Arterial streets are high speed streets. Arterial streets are often constructed as six lane divided facilities, with three lanes for the movement of cars in each direction separated by a grass strip. Six lane arterial streets are capable of safely moving no more than 1800, 2400 or 4500 cars an hour in one direction, depending on the type of intersection they are provided with.

3. The capacity of most streets, the highest number of cars that can safely move down a street in one hour, is limited by their intersections. Where two streets meet and a considerable number of cars use the streets, their intersection must be provided with signals, traffic lights, to prevent accidents and to permit the cars on the less heavily traveled road to have a chance to cross the more heavily traveled road. But in addition to making the roads safe, the construction of signals at street intersections also reduces the capacity of the roads. For periods of time during each hour, the cars on both roads must stop at red lights. In most cases not more than 600 cars an hour can be moved across a signalized intersection in each lane of a road during green light periods. It is this intersection control that limits the safe capacity of service streets to 600 cars per hour in one direction(as only one lane is provided in each direction), of collector streets to 1200 cars per hour (as two lanes are provided in each direction), and of arterial streets to 1800 cars per hour, (as three lanes are provided in each direction). An arterial street might be widened to eight lanes at signalized intersections, resulting in four lanes for the movement of cars in each direction. By doing this, the capacity of the street could be increased to 2400 cars per hour in each direction: four lanes at 600 cars per lane.

4. Where more than 2400 cars an hour must move in one direction across an intersection, signalized intersections cannot be used, and an overpass-type intersection, often called an "interchange", must be constructed.

At an overpass-type intersection one street is carried over the other on a bridge, so that the cars using the two streets do not meet one another, and additional street sections are built to permit cars to turn off each street on to the other. Overpass-type intersections are also built where one of the streets is a high speed roadway, such as a turnpike or freeway, and the stopping of its traffic at signalized intersections is not desirable. Under this condition overpass-type intersections will be built even though neither of the two intersecting streets has over 2400 cars in one direction.

5. Although streets may be needed for the movement of cars, they will not be constructed and maintained if they do not leave the specific qualities that are needed. An arterial street will not be built if a service street is really needed, and an overpass-type intersection will not be built at the intersection of two service streets. The number of streets must also be needed. Two streets will not be constructed alongside of one another if one street would fill the same need.

6. Once it is determined that roads are needed of a specific quality and number, they must be located to efficiently provide their service: the provision of the shortest economical routes for the movement of cars from one area to another, from the places where the car trips start to the places where they stop, from the places of origin of the car trips to their places of destination.

7. The car trip from home to work consists of movement of the car from a place of origin (the housing unit) to a place of destination (the employment location) along a route (a street). The shortest route for such a trip is a straight line from the housing unit to the employment location. If there was only one housing unit in a community, a street would be created that generally followed this line. But communities contain many housing unit places of origin and one or more employment destinations.

8. Movement of cars from a number of housing areas to an employment destination results in a branch-like route system where routes giving access to each housing unit, service roads, are collected to become collector streets that run directly to the employment location. Movement from a number of housing areas to a number of employment destinations results in a system of overlapping branched routes resembling a web. But although each route is efficient in that it provides for movement by the shortest means from each housing area to each employment destination, the entire system is not economical as there are many long roads going in the same general directions. Because this is uneconomical, then long roads are collected into a few arterial streets that still provide reasonably short travel routes but results in fewer streets that must be built.

9. Were there no other influences on efficient street location than the desire to minimize the length and number of streets required, all communities

could be built with street systems like that described above. But other influences further alter the origin and destination route pattern.

10. The slope of the land and other ground conditions effect street locations. Roads must be built around steep hills, although the shortest route would go over the hills, and small swamps often exist requiring roads to be built around them. And one of the strongest influences that results in changing the origin and destination street pattern is the existence of streets built at an earlier time.

11. When roads are constructed, the land beneath the road is gained by the community for community property. When roads already exist where new street needs are created, it is usually more economical to widen the existing road on land the community already owns than it is to build a completely new street along an origin and destination line that requires the purchasing of more property. For this reason, origin and destination street patterns are generally adjusted to fit nearly existing streets.

12. Where no ready streets exist, or where the community property available at the sides of existing streets is not wide enough to permit the streets to be economically widened, new streets are built. But such new streets also rarely exactly follow origin and destination lines as their location is influenced by the shape of the properties that the new street is to cross. Wherever

fit is possible, new streets are built along property lines with one half of the road on one property and the other half on another. In this way the least possible area of property is needed from each land owner and when new streets do not follow property lines, but cut across properties, small odd-shaped pieces of land are left at both sides of the street that are difficult to develop. When land is divided into rectangular properties, new streets will generally be built following the directions of the property lines, at the property lines, for these reasons.

13. The construction of new streets at origin and destination line locations would often require that they be built through developed areas. In many cases it is more economical to locate such new streets to go around developed areas as the cost of the longer road may be less than the cost of buying developed sites and demolishing their structures.

14. The location of streets is the result of changing the most economical and shortest origin and destination line routes to fit the slope of the land, land surface features, existing streets, the shape of properties and the location of existing developed areas.

15. Streets provide for their own need for service as the only service they require is access for repair and maintenance vehicles that is provided by their own surfaces.

16. Streets are generally built on firm or hard soils. Soft soils are avoided wherever possible as most roads must carry heavy trucks from time-to-time that require firm road support. And because trucks and cars have difficulty climbing steep hills, streets are generally constructed on flat or sloped land, or are built across steep slopes keeping the slope of the road surface itself as flat as possible.

17. Street building costs consist of two factors: (a) the cost of the road itself, and (b) the cost of the land the road occupies. Streets providing access from one part of the community to another are so essential to the community system that high land price rarely prevents their construction. However, insofar as streets must be paid for by the community as a whole and bring no direct profit to the community from their construction, low priced land is sought for streets in order to keep the community cost as low as possible. But streets will be built on high priced land of the total cost of building a longer road on low priced land is higher then the total cost of building a shorter road on high priced land.

Illustrations:

1. Diagram of service street giving access to sites, showing capacity.
2. Ground photo of service street.
3. Diagram of collector street giving access and collecting service streets, showing capacity.
4. Ground photo of collector street (four lane).
5. Diagram of arterial street showing capacity.

Reading Assignment
Day 160 (continued)

6. Ground photo of arterial street (six-lane - divided).
7. Ground photo of signalized four-way intersection.
8. Diagram of intersection capacities by load type and intersection type.
9. Air photo of six-lane divided arterial street widened to eight-lanes at signalized intersection.
10. Air photos of interchanges on six-lane highways (cloverleaf).
11. Diagram of single origin and single destination (shadow line).
12. Diagram of multiple origins and single destination (branched).
13. Diagram of a number of multiple origin areas and multiple destinations (web).
14. Diagram of web origin and destination lines, "collected" into arterials.
15. Air photos of roads routed around steep hills and swamps.
16. Ground photo of street widening.
17. Air photo of street built following property lines.
18. Diagram comparison of street built across properties vs. following property lines.
19. Air photo of street routed around developed area.
20. Air photo of street cut through developed area.
21. Photo of road across a steep slope.
22. Air photo (overall) of a community emphasizing street patterns (preferably non-grid).

SCHOOL CONSTRUCTION

Reading Assignment
Day 161

1. Families living in housing units need schools for the education of their children. The need for school construction is created by the construction and sale of housing units.

2. Two kinds of schools are usually constructed in a community: (a) elementary schools, and (b) junior-senior high schools. In some areas, the elementary schools contain Grades 1 through 8, in which case senior high schools are constructed to contain Grades 9 through 12. In other areas, separate junior high schools are built containing Grades 7 through 9, senior high schools containing Grades 10 through 12, and elementary schools containing Grades 1 through 6. In still other areas, elementary schools are built containing Grades Kindergarten through 6, and a combined junior-senior high school is built containing Grades 7 through 12. The elementary schools and junior-senior high schools referred to in this text are of this last type.

3. Virtually all housing units need school service, but before a school is built in a community, it must be shown that a school can be supported. A community consisting of 550 or more housing units can generally support the construction of an elementary school. If a community has less than 550 housing units, the number of elementary school-age children in the community will usually be so low as to make the construction and operation of an elementary school extremely expensive and inefficient. When communities have less than

550 housing units, it is common for a number of such small communities to combine their efforts in the construction of a single school serving a number of communities, with the school children transported by bus to the school each day. If a community contains more than 550 housing units, elementary schools will generally be built in the community to fill its need for elementary school facilities.

4. But more support is required for junior-senior high school construction. Junior-senior high schools will generally be built in a community if it contains more than 3,000 housing units. If the community has less than 3,000 housing units, the costs of construction and operation of a junior-senior high school become very expensive because of the need for special classrooms, equipment, and teaching staff, and the school becomes very inefficient. Communities with less than 3,000 housing units usually send their junior-senior high school-age children to central schools outside of the community, or to the school facilities of nearby larger communities that can support such construction.

5. Schools also have a maximum number of housing units they can serve. When this is exceeded, the school becomes so big as to be costly and inefficient. An elementary school generally cannot efficiently serve less than 550 housing units, or more than 2,300 housing units. Similarly, junior-senior

high schools generally cannot efficiently serve less than 3,000 housing units, or more than 11,000 housing units. When more housing units exist than a school can efficiently serve, another school must be built.

6. When a school is proposed to be constructed, the specific qualities of the school must be needed. An elementary school will not be built if a junior-senior high school is needed, and a large junior-senior high school with a capacity for serving 11,000 housing units will not be built if just an average school with a capacity for serving 7,000 housing units is needed.

7. The number of schools to be built must also be needed. Two elementary schools, each serving 550 housing units in a neighborhood, will not be built if one elementary school serving 1,100 housing units would serve the neighborhood as well.

8. Schools must be located to efficiently provide their service to the housing units they are constructed to serve. The location of housing units in a community limits the location of elementary schools, as it is common to expect young children to walk to school from their homes. Elementary schools, providing education facilities for children as young as five or six years old, must be located near the homes of the children they serve. To reasonably provide its service function, an elementary school must be located in such a manner as to require each child attending the school to walk no more than one-half mile

from his home to the school. When child-walking distances are longer than one-half mile, school bus transportation service must usually be provided, at a continuing cost to the community. The walk from home to school must also be safe. Elementary schools should be located so that children do not have to cross heavily-traveled streets during their walk from home to school.

9. The youngest children attending junior-senior high schools are much older than the youngest children attending elementary schools, and they are capable of walking farther during their trip to school. But the junior-senior high schools must still be located with walking distances in mind, as it is generally held that a junior-senior high school student should not have to walk more than one and one-half miles during his walk to school. Students living beyond one and one-half miles from a junior-senior high school generally require school bus transportation, at a continuing cost to the community. In addition, junior-senior high schools must be located on or near a major road as many activities at the school site, such as football games, plays and community meetings, will create a great amount of auto traffic at the school site.

10. Schools also have their own service needs that must be fulfilled. Both elementary and junior-senior high schools require sites where utility service is available, and need road access for automobiles of the teachers and staff, and for maintenance and repair vehicles.

11. Both elementary schools and junior-senior high schools need sites with firm or hard soils to support the school construction, and flat or sloped sites. Steep sites are extremely difficult and expensive to build on, and the provision of reasonably flat playing fields at school sites is very expensive when the ground is steep, requiring a great deal of earthmoving and expensive retaining wall construction.

12. Sites for schools should be undeveloped, low-priced ground, as the total community cost of school construction should be kept as low as possible. No benefit occurs from the selection of expensive sites, or sites requiring the purchasing and demolition of existing buildings, if less expensive sites that meet all of the school requirements are available. Schools require large areas of land. An elementary school usually needs a site of from five to ten acres, or more, whereas a junior-senior high school generally needs a minimum of twenty acres, and perhaps as much as forty acres. All this land, the cost of constructing the schools, and continuing bus transportation costs, must be paid for by the community in order to provide school service to the residents of housing units constructed in the community.

Reading Assignment
Day 161 (continued)

Illustrations:

1. Photo of average elementary school
2. Photo of average junior-senior high school
3. Plan diagram of elementary school walking limits and zone of bus service
4. Plan diagram of junior-senior high school walking limits and zone of bus service
5. Photo of large number of cars parked at junior-senior high school during football game
6. Diagram comparing site sizes of various school types and capacities
7. Photo of elementary school children crossing busy street

BUILDING LOCAL SHOPPING CENTERS

Reading Assignment
Day 162

1. Families living in housing units not only need school facilities for their children, but also create the need for construction of shopping and business facilities from which they can obtain the goods and services they need in their everyday lives.

2. These needed shopping and business facilities are the places of work for many service workers in the community--workers supported by the people working at the primary community construction object--many of whom provide their services to families living in local neighborhood groups of housing units, rather than to the families of the community as a whole. They provide for retail sales at grocery stores, drug stores, and eating and drinking establishments, personal services at barbershops, beauty parlors, shoe repair shops, laundries and dry cleaning shops, auto services at gasoline stations and repair garages, professional services at medical and dental offices, and business services at real estate offices, loan offices and many other kinds of offices serving a particular group of housing units in the community.

3. The trade area of such local shopping and business facilities, the area of residence of the families they serve, is generally small and close to the location of the facilities. Because of this, a community will usually have many groups of local shopping and business structures located throughout the community, each serving its own group of housing units.

4. The need for local shopping and business services, created by the construction and sale of housing units, is fulfilled through construction of many kinds of stores and offices, as well as gasoline stations, auto repair garages,and parking lots for the cars of the people using these facilities. These constructed objects are generally grouped into two types of developments: (a) "strip" shopping areas, and (b) local shopping centers.

5. All local retail sales and auto service facilities depend for their success on a great amount of auto traffic passing their location, permitting many residents of their local trade area to stop at their establishments while traveling to other areas of the community. Local personal services, professional services and business services usually locate close to retail sales facilities in order to attract customers going to the retail sales location. They share the customers of the retail sales facilities. This sharing of business tends to increase the business of both the retail sales establishments and their closely-related shops for personal, office,and business uses. The success of the personal services, office and business uses depend on the success of the nearby retail sales facilities, which, in turn, depend for their success on a location on a heavily-traveled street.

6. When objects constructed for local shopping and business services are located along a busy street, stretched out over the length of the street, "strip" shopping areas are created. In most "strip" shopping areas, each store and shop is individually designed and constructed, and

advertises its existence by construction of a sign at the roadside. This results in a clutter of unrelated building locations, sizes, colors, and materials, many individual small parking areas, and hundreds of signs that confuse the drivers on the road, thus defeating the communication purpose of each sign. Access to each small parking area is gained directly from the heavily-traveled road. This results in a large number of small driveways that confuse the driver, an increase of accidents on the road caused by the confusion of cars leaving and crossing the road at many places, and a reduction of road capacity caused by the slowing of traffic which, in turn, creates street congestion and traffic jams.

7. When objects constructed for local shopping and business services are grouped into a compact unit located at the intersection of two busy streets, local shopping centers are created.

8. Local shopping centers generally consist of a group of large structures housing many individual stores and shops. These centers are usually totally designed in such a manner as to result in planned relationships between building locations, sizes, colors and materials. Instead of many small parking lots, each serving its own store or shop, one large parking lot is created serving all of the stores and shops in the center, with just a few driveways for access from the surrounding roads, each of which is located and designed to minimize street confusion and congestion.

9. The local shopping center, being a group of structures designed as a unit, is its own best sign. Its physical form and location make it stand out from the clutter of the roadside, advertising its existence, and people tend to drive to the center, rather than to any of its individual stores. Because of this, few signs are needed and the clutter of signs caused by "strip" shopping developments is replaced by just a few signs bearing the center's name.

10. All housing units in a community need shopping services, but not all communities can support local shopping centers of their own. The smallest local shopping center requires at least 1000 housing units in its trade area for support. If a community has less than 1000 housing units, local shopping centers will not be constructed, and housing units in the community will gain their needed shopping services either at individual stores and shops in the community, or from shopping centers in nearby communities.

11. But even if a local shopping center is supportable by the number of housing units in a community, it will not be built and maintained if its specific qualities and the qualities of the stores it contains are not equal to the needs of the families in its trade area.

12. Local shopping centers, usually ranging from one to ten acres in site size, require parking areas on their sites that occupy at least

two-thirds of the site area. If a local shopping center is built with too little parking, it will not be able to park the cars of the customers it needs to be a success, and the center will fail. Similarly, if stores are built in a shopping center that cannot be supported by the families in its trade area, the stores will fail and stand vacant. Although more than 1000 housing units might exist in the trade area of a local shopping center, an expensive delicatessen constructed in the center will not be built, or will fail if it is built, if the housing units are occupied by low income families who cannot afford to purchase the products that the delicatessen has for sale. The specific shop type and size of each shop in a local shopping center must be supportable by the families in its trade area.

13. The number of local shopping centers in a community must also be supported by need. Three local shopping centers would not be built or maintained in a community of 2500 housing units, as each local shopping center requires a minimum of 1000 housing units in its trade area.

14. In order to efficiently provide their services to housing units, local shopping centers should be located at the intersections of arterial or collector streets with other heavily-traveled streets giving access to a large number of housing units, maximizing driver access to the centers. In some situations, vacant corner sites of this type are not available because of prior construction and the cost of buying the land and the existing buildings is too high to permit a reasonable profit from development for a local shopping center.

When this is the case, sites along arterial or collector streets that are not at important intersections are often selected for local shopping center construction. But locations at the intersections of major streets are the best sites for such centers.

15. In addition to needing locations near heavily-traveled streets, local shopping centers need sites that are serviceable by all utilities, and which have more than 1000 housing units within one mile, if they are to fulfill their own needs for service and support.

16. Firm or hard soils are required for local shopping center construction in order to support the weight of the buildings, and flat or slightly-sloped land. Steep land is rarely used for a shopping center construction because the construction of safe and efficient parking areas, and large one-story buildings, on steeply-sloped land is expensive.

17. The land price of sites for local shopping centers is generally high because of their location at arterial or collector streets. The total land price of a site will be particularly high if it is presently developed and purchasing and demolition of existing buildings is necessary to clear the site for local shopping center construction. But the profit from successful construction and sales of local shopping centers is also high, permitting local shopping centers to be constructed on land priced so high as to make development for housing impossible. In some cases, however, the total price of a

site is so high as to make the construction of a local shopping center impossible also. This is the case when the cost of the land, and the purchasing and demolition of any buildings that might be located on it, added to the construction cost of building the shopping center, equals or exceeds the possible income from sale of the center. When this condition exists, no money is left for the developer's overhead and profit, and the local shopping center will not be built. As long as the total price of the land for a local shopping center is such as to permit a reasonably large profit from construction, the center will be built and maintained, if it also meets all other factors of need, function, and land.

18. Local shopping centers are a part of the total community system. Their location, character, and number are determined by the needs for local shopping and business services that are created by the construction and sale of housing units, and the location and character of roads built to serve these housing units. Housing, in turn, is created to fulfill needs of the manpower employed at the primary construction object and of the manpower filling service jobs created by this employment. The primary construction object, in turn, is created to fulfill a regional or national need related to resource development, change of transportation, economic processing of materials, defense, or politics.

19. Because local shopping centers are a part of this community system, the general location, character and number of local shopping centers to be built and maintained in a community are actually determined at the time that a decision is made to build, expand, reduce, or eliminate an employment center at the general site of the community. If a decision is made to increase employment at a primary construction object, more housing units, roads, schools, and local shopping centers will be built at locations determined by their factors of function and land. If a decision is made to greatly reduce employment at the primary construction object, a number of houses, schools, and local shopping centers will lose their supporting need, and will stand vacant and unmaintained, while roads and utilities built to serve a larger population will be inefficiently used. The type, location, character, and number of all constructed objects in a community are similarly related to decisions affecting employment at the primary construction object.

Illustrations:

1. Photo of people working in grocery stores
2. Diagram showing service jobs in local shopping center
3. Plan diagram of a number of local shopping centers in a community and their trade areas
4. Photos of stores, gas stations, and local offices under construction
5. Diagram of relationship of local shopping to roads
6. Ground photo of chaos of "strip" area
7. Air photo of local shopping center
8. Ground photos of well-designed local shopping centers
9. Diagram of local shopping center, its trade area, and minimum number of housing units in trade area
10. Plan diagram of local shopping centers at intersections and along major streets
11. General photos of well-designed local shopping centers

HIGH DENSITY HOUSING

Reading Assignment
Day 163

1. As a community's population and area of development expands, undeveloped sites available for the construction of low-density, single-family housing units become farther and farther away from employment locations, primary construction objects, and business areas. As this distance increases, worker travel costs increase, in terms of both time and money. Community expansion also results in the increase of land price of sites close to these employment locations. This increase is caused by two factors: (a) the potential for expansion of the employment centers themselves, and (b) the potential use of this land for housing close to these employment centers.

2. The increased land price of sites close to employment locations reduces the potential for their development for low-density, single-family housing units. In housing construction, increased land price must result in either (a) decreased profit, (b) increased sales price per housing units, or (c) an increase in the number of housing units built on the site to lower the per-unit land cost.

Insofar as housing developers are in business to make a profit, profit is rarely reduced because of a high land price. A significant increase in the sale price of single-family housing units usually reduces the market for the units, as single-family units are generally available at lower prices at the perimeter of the area of community development where land prices are low. Because of these factors, the increased land price of sites near employment centers usually results in the development of these sites for high-density housing, spreading the land price over many housing units, rather than low-density, single-family housing.

4. Where high land price of land close to employment centers exists in combination with a high demand for housing and a scarcity of low-priced, undeveloped land near the employment centers, a need for the construction of high-density housing units is created.

5. Before high density housing units are built to fill this need, the specific qualities of the housing units needed must be determined. Multiple-family housing units, attached units less than four stories high served by stairways, can be built for all income levels, but, in general, the lower the density of such units, the higher the income level required to support them due to the per-unit increase in land price. For example, multi (15) housing developments (multiple housing units built at a density of fifteen (15) units to the acre) would generally require middle income support, whereas development for multi (25) housing could be built for lower income families. High-rise housing, attached housing units of four or more stories served by elevators, can be built for all income levels, but such units are generally high priced housing units because of their increased construction cost per unit, especially when the buildings are well above four stories in height.

For example, high-rise (60) housing developments, housing units built in tall buildings at a density of sixty (60) units to the acre, usually require high income support.

6. High-rise housing will not be constructed simply on the knowledge that high density housing is needed for high income families. The number of such housing units supportable by the housing market must also be known. The construction of ten (10) acres of high rise (60) housing units, resulting in the provision of six hundred (600) high income housing units, will not be undertaken if only one hundred (100) high income families need housing.

7. In order to provide for low transportation costs and travel time to employment locations, high-density housing must be located on sites near major streets, collectors or arterials, as close as possible to employment locations. Sites directly on arterial streets or at, or near, the intersections of arterial streets, are the best sites for high-rise housing developments because they permit quick access for many workers to many parts of the community.

8. Sites at or near important streets permit high density housing developments to be served by maintenance and supply vehicles, providing for their own need for access. High density housing developments must have all utilities available at their sites in order to provide the water, sewer, gas, electric, and telephone services needed for their operation. The best sites

for high density housing are also located near shopping, school, and recreation facilities, in order to efficiently provide the families living in these housing units with the services they require.

9. The construction of multiple-family, high density housing units requires sites with firm or hard soils to support the weight of the structures, whereas high-rise housing construction usually requires sites with hard soils because of the great weight of these tall buildings. All types of high density housing can generally be built on flat, sloped, or even steep, land; the increased cost of building on steep slopes being made up through construction of a great number of housing units, spreading this cost over many units.

10. Land price influences the type of buildings that will be built for high density housing, and determines the number of housing units that must be built on a site to result in a reasonable profit.

11. The number of high density housing units to be built on a site directly reflects land cost: the higher the land cost, the more units that must be built. As the number of units that must be built on a site increases, the type of buildings needed to house the units must change. Because of these factors, land price determines high density housing building type.

12. Where more than twelve (12) housing units must be built on a single acre of ground in order to result in a reasonable profit, there simply will not be enough land for roads, buildings and private yards to permit the construction of single-family housing units. When housing densities of more than twelve (12) housing units per acre are required, units must be attached, side-to-side, eliminating side yard spaces, and upper stories must be used for housing, resulting in construction of multiple-family housing units. Development at or near this density usually results in the building of two-story rowhouses or apartments.

13. If more than thirty (30) housing units per acre are required to result in a reasonable profit from development, there will not be enough ground space for roads, parking, yards, and buildings for two-story structures. Development at this housing density requires that housing units be stacked on top of one another, resulting in multiple-family apartment buildings three (3) stories high. When more than forty-five (45) housing units to the acre are needed, buildings over three (3) stories high must be built. Such buildings require elevator service, resulting in the construction of high-rise apartment buildings.

14. When more than seventy-five (75) housing units per acre are required, the high rise apartments must be over six (6) stories high; if more than ninety-five (95) housing units per acre are required to result in a reasonable profit from development, the high-rise structures will have to be over thirteen (13) stories in height.

15. With increased land price, both the type and height of buildings for high density housing must change. The construction of multi-story buildings of high density housing is determined by land price and market demand which, in turn, are determined by prior community construction and employment at the primary construction object.

Illustrations:

1. Diagram of those alternative results of increased land price on housing development
2. Air photo of multi (15) housing
3. Ground photo of well-designed multi (15)
4. Air photo of multi (25) housing
5. Ground photo of well-designed multi (15)
6. Air photo of high-rise housing
7. Ground photo of well-designed high-rise
8. Diagrams of good locations for high density housing
9. Photos of multi and high rise housing on steep slopes
10. Air photo of SF(1), SF(11), and SF(12), oblique
11. Air photo of multi (15), oblique
12. Air photo of multi (25), oblique
13. Air photo of high-rise (60), oblique
14. Air photo of high-rise (80), oblique
15. Air photo of high-rise (100), oblique
16. Diagram of land price in relation to building size and height

COMMUNITY RECREATION

Reading Assignment
Day 165

1. The need for construction of community recreation facilities arises from the sale of housing units, creating a population needing outdoor areas for play, games, sports, and quiet rest, and the construction of these housing units in such a manner as to result in privately-owned outdoor spaces that are too small to fulfill these purposes. Where a number of housing units have been built and sold in an area, and individual backyard areas are not adequate for recreation purposes, community recreation facilities must be constructed.

2. In rural areas, and in areas developed for housing with large lots, resulting in a density of less than five (5) housing units per acre, recreation needs are generally met on individual properties, in backyard areas, and the construction of recreation facilities usually is not needed. But where areas are developed more intensely, resulting in densities of five (5) housing units to the acre or more, these private backyard spaces are too small to fulfill the recreation needs of the population, and these needs must be met through the purchasing of property and the construction of recreation facilities.

3. Although the construction of recreation facilities is generally required when housing units are constructed at five (5) housing units to the acre or more, they will not be built and maintained if their specific qualities

are not supported by need. There are many kinds of recreation facilities, including playgrounds, playfields, neighborhood parks and community parks, each of which has its own distinct qualities and fulfills a different need. A playfield will not be constructed and maintained in a housing area if a neighborhood park is what is really needed.

4. Playgrounds are recreation facilities built to fulfill the recreation needs of pre-school and elementary school-age children. Playgrounds generally contain play equipment, swings, slides, climbing bars and sandboxes, and small open spaces for games. They usually require from one (1) to ten (10) acres of land, depending on the number of small children they serve.

5. Playfields are constructed to meet the recreation needs of older children--children of junior and senior high school age, and adults. They generally include all of the elements of the playground and, in addition, facilities for team sports, such as full-size baseball, softball and football fields, tennis courts, and basketball courts, stadia for the seating of spectators, and parking facilities for the cars of the older children and adults using the facility. Playfields also often contain indoor recreation facilities, buildings housing dancing areas, table tennis facilities, and rooms for arts and crafts. Playfields require large land areas, usually from ten (10) to twenty (20) acres or more, depending on the number of older children and adults they serve.

6. Both playgrounds and playfields are active recreation facilities. They are built to meet needs for individual and group activities requiring a considerable output of energy on the part of the user. Passive recreation facilities are also required in a community: restful outdoor areas for the use of children and adults.

7. Neighborhood parks are passive recreation facilities built to provide restful places near housing areas. They generally contain shady walks, benches, fountains, planted areas, and large lawns, resulting in a pleasant, peaceful, outdoor environment for relaxation. When housing units are constructed at densities of less than five (5) housing units to the acre, this peaceful area for relaxation is generally available in each housing unit's yard. But where housing is built at higher densities, individual yard spaces usually either do not exist, or are too small for such use and nearby neighborhood parks must be constructed. Neighborhood parks vary greatly in size, depending on the availability of land and the number of people needing the facility. But neighborhood parks smaller than one (1) acre are generally not built and maintained, as their maintenance costs are usually too high for their limited use.

8. In addition to neighborhood parks, community parks are usually needed in a community. Community parks are passive recreation facilities providing outing, picnicking, hiking, boating, and often swimming--facilities

for use of all the families in the community. Areas of the community with unique features, such as heavy woods, streambeds with waterfalls and rapids, and attractive river fronts or lake shores, are often preserved for the free use of all of the citizens of the community, and for future generations, through their development for community parks. As the population and physical extent of communities increase, it is often necessary to purchase large areas for wildlife refuges and natural wilderness areas, assuring that they will not be built upon, and that future generations will be able to experience the natural, untouched world of wild animal life and woodlands. Insofar as community parks serve the entire community, they are usually quite large. Community parks of twenty (20) acres or more are common.

9. The number of each type of recreation facility to be constructed must be needed. Two neighborhood parks which would serve a single area of housing would not be built, as construction and maintenance costs increase with the number of facilities. Six separate community parks generally will not be constructed if one site exists which could fulfill the need for community parks. And the total number of acres of land in the community used for recreation must be supported by need. As a general rule, at least one (1) acre of recreation space is needed for each 285 housing units. The total area of all playgrounds, playfields, neighborhood parks, and community parks in a community with 28,500 housing units should be approximately one hundred (100) acres or more. If less than one hundred (100) acres is provided for recreation developments, the recreation needs of the community will not be met.

10. Recreation facilities of all types must be carefully located to assure that they efficiently provide their services to the residents of housing units.

11. Playgrounds are usually located on the same site with elementary schools, as the maximum desirable walking distance for young children from their homes to a playground is the same as from their homes to school--one-half mile. Elementary schools need outdoor play spaces and equipment for their physical education programs. A playground located on the same site with an elementary school provides for the needs of the school's educational program as well as the need for after-school child play through construction of one (1) facility. When housing is constructed at a density of five (5) housing units per acre or more, and children are transported to elementary schools, the school being more than one-half mile away, playgrounds must be built near the housing units to provide for after-school play and preschool-age child play. This results in the construction of two playgrounds to serve the same housing units: one at the location of the housing units, and another at the elementary school site.

12. Playfields are commonly constructed on the same site with junior-senior high schools, providing spaces and equipment for school sports and physical education programs, and utilizing the school's parking facilities for recreation parking after school hours and on weekends.

13. Neighborhood parks--peaceful, outdoor relaxation areas--must be located no more than one-half mile from the housing units they serve in order to permit elementary school-age children to walk to the facilities. These parks are often built near elementary schools, as their walking limits are the same and the child-paths from housing units to both schools and neighborhood parks should not cross busy streets.

14. But neighborhood parks constructed to serve multiple-family or high-rise housing units must be close to the housing units they serve. These dense housing developments rarely have adequate, safe, yard spaces for preschool-age child play, and neighborhood parks are used for this purpose. The preschool child, being younger than the elementary school child, should not be expected to walk one-half mile to a park. For this reason, a neighborhood park serving multiple-family or high-rise housing units should be located no more than one-quarter mile from the housing units it serves, and should not require small children to cross busy streets during their walk to the parks.

15. Community parks should be located along or near major roads, permitting large numbers of people to drive to the parks. Open space purchased for flood protection purposes is often used for community park purposes, since it provides large areas of undeveloped ground that can be developed for community parks at little cost, serving double purposes: both flood protection and community recreation.

16. Recreation developments of all types must be located on sites that provide for their own service needs. All recreation developments require maintenance of grounds and equipment, and must be located along, or near, a road giving access to their sites. Water, electric, and sewer service is usually required at sites for community park and playfield developments, in order that restrooms and lighting can be provided. Playgrounds and neighborhood park sites need water service to provide water for their drinking fountains.

17. Insofar as little heavy building construction is undertaken at playground, neighborhood park, or community park sites, they can be located on soft ground as well as firm or hard soils. But playfields, usually requiring construction of stadia and buildings for indoor recreation, require firm or hard soils. Land slope is usually not a factor in locating neighborhood parks and community parks, as hiking paths, picnic areas, shady walks, and small areas for child play can generally be provided on all slopes. Playgrounds and playfields require flat or slightly-sloped ground because game areas and sports fields must be almost flat.

18. Because recreation land produces no community income and must be paid for by the community, inexpensive, undeveloped land is usually sought for recreation construction. But such cheap land is often not located well to serve the community as a recreation facility and expensive land must often be purchased in order to fulfill the community's need for recreation

services. Sites for recreation are also expensive because the same construction activity that results in the construction and sale of housing units, creating the need for recreation developments, raises the land price of the surrounding undeveloped land that is available for recreation use.

Illustrations:

1. Photo of children playing ball, papa and mama relaxing in landscaped backyard of low density housing unit, SF(1)
2. Children playing in the street in high-density housing area, SF(7)
3. Photos of well-designed playgrounds and equipment
4. Photo of well-designed playfield
5. Photos of well-designed neighborhood and community parks
6. Photos of wildlife refuges and wilderness preserves
7. Diagram of relationships between housing units and acres of total recreation space
8. Photo of playground at elementary school
9. Photo of playfield at junior-senior high school
10. Comparative diagrams of playground and neighborhood park walking distances
11. General photos of well-designed recreation facilities

CENTRAL BUSINESS CONSTRUCTION

Reading Assignment
Day 167

1. As the population of a community increases, the services needed by the population also increase. Many of these services are offered to the entire community, and require the support of the entire community rather than just the support of the residents of a local neighborhood area.

2. Retail sales services offered by large department stores, clothing, shoe and furniture stores, and auto showrooms, as well as food services offered by fine restaurants, and entertainment services offered by theaters for stage shows, movie houses, and clubs, generally serve all of the residents of a community and need their support. Professional services offered by specialized medical and dental offices, the offices of architects, lawyers, engineers, and administrative services offered by offices of the community, state and national government, insurance, banking, real estate, construction and utility companies, usually also provide for the needs of the entire community.

3. These services, requiring the support of the entire community rather than the support of any particular neighborhood, need community-related locations rather than the local neighborhood-related location of local shopping centers.

4. Whenever the need exists for services offered to the entire community, requiring the support of the entire community, central business

construction will be undertaken to fulfill this need, resulting in the construction of office buildings, theaters, large and small stores and their parking lots, and garages, at locations selected to permit these structures to efficiently serve the entire community.

5. But before central business construction is undertaken, it must be shown that the specific qualities of the objects to be constructed are needed. An office building will not be built and maintained if a restaurant is all that is needed. And parking garages will not be constructed if there is no need for the parking of cars at a site.

6. The number of facilities to be constructed must also be needed. A million square feet of office space will not be built and maintained if only one thousand square feet of office space are needed. Three parking garages, each containing 200 cars, will not be built if one garage for 600 cars would fulfill the same need. In general, no more than one acre of central business construction will be supported by each 350 housing units in a community, and much less area is required if central business needs are met through construction of tall buildings.

7. Once it is determined that a need for central business construction exists, and that a market exists for the specific qualities and number of objects proposed to be built, the objects will be constructed and maintained, if they are well-located and are sited on land permitting their economical development.

8. In order to efficiently provide their community service, central business construction objects need sites that are located at the intersections of the most important streets of the community, permitting quick access from all areas of the community. These major streets often intersect at or near the center of the developed area of the community. For this reason, construction undertaken to provide shopping and business services to the entire community is called "central business construction."

9. In the past, all central business construction was undertaken at the center of the community--the area commonly called "downtown"--because this location provided for quick access along major roads from all parts of the community. Those "downtown" areas became tightly packed with buildings built right up to the streets. But as the population of communities increased, and car use increased also, the streets in downtown areas became congested. This reduced their capacity, causing traffic jams, and lengthened the time of trips from housing units to the central business facilities. The existence of large buildings right at the sides of the downtown streets made it economically impossible to widen the downtown streets to reduce the congestion. And as the communities expanded, new housing areas were created farther and farther away from downtown, further lengthening the time of trips to the central area.

10. As the population and area of development of our communities continued to expand, new arterial streets were built, not only from housing areas to the central area and to employment locations, but also between housing areas, permitting cars to bypass the congested downtown area. As more areas of housing were developed beyond these arterial streets, locations at the intersections of these new arterial streets with major streets running to the central area became more easily and quickly accessible from housing areas than the downtown area. Because of this, "central" business facilities were constructed at these locations, resulting in the development of community and regional shopping centers. These shopping centers, although not really central in terms of their location, fulfill the same needs and require the same general location and land conditions as central business construction.

11. Central business construction objects, either downtown or at community or regional shopping centers, require sites with all utility services available, and use the major streets at the intersections of which they are located for access for service, supply, and maintenance vehicles. Sites for central business construction must also have either firm or hard soils to support the weight of the structures, and usually require flat or slightly-sloped land, permitting easy auto and pedestrian access.

12. Sites for central business construction generally have the highest land price of all the sites in a community. But profits from their development are also high, permitting their development. As with high-density housing, the higher the land price, the taller the structures must be in order to spread the high land price over more facilities. New York City has very tall central business buildings because of (a) the high market demand for their use, (b) a small land area available for construction due to the fact that the center of the city, Manhattan Island, is surrounded by water, (c) a high land price caused by the high demand and limited area for development, and (d) the existence of hard rock, permitting support for the great weight of such tall buildings.

Illustrations:

1. Photo of a large downtown department store, theater, and office building, preferably all in same photo
2. Diagram comparing good sites for local shopping centers with good sites for central business construction.
3. Air photo of a downtown clearly developed at intersection of two major streets
4. Ground photo of street congestion in downtown area and large buildings built up to the streets.
5. Air photo, or diagram, of outerbelt arterial streets
6. Diagram of community and regional shopping center locations
7. Air photos of well-designed community and regional shopping centers located at outlying arterial street intersections
8. Ground photos of well-designed downtown areas (mall, trees, attractive buildings) and well-designed shopping centers
9. Air photo of Manhattan Island, showing tall buildings and surrounding area (oblique)
10. Ground photos of large business buildings in New York City

ECONOMIC LOSS AND COMMUNITY DEVELOPMENT

Reading Assignment
Day 168

1. Every community is born with the building of a primary construction object that creates employment, and grows with increase of this employment and the construction of objects needed to fulfill the needs of the workers in the community and their families.

2. A healthy community is one with steady or increasing employment and consists of constructed objects that efficiently fulfill the needs of its population. In a healthy community, each constructed object is supported by a market for its type, specific qualities and number, is located to efficiently provide its service and the services which it needs, and is constructed on land, the physical qualities and price of which permits its economical construction and maintenance.

3. In a healthy community, all buildings are occupied and all community facilities are utilized. All objects in a healthy community are in good physical condition. They are well-maintained through constant repair activities undertaken to permit them to continue to effectively serve their purpose and to retain their economic value.

4. However, most communities contain at least a few constructed objects that are poorly maintained and, because of this, exist in a poor physical condition. Such structures are said to be deteriorated. At first, these structures simply need a coat of paint, or need to have a broken

window, a missing step, or a few missing bricks, replaced. But as time passes and no repairs are made, wooden parts of the structure rot, metal parts rust, brickwork cracks, roofs sag, the structure itself becomes unstable, and finally, collapses into a pile of rubble. All constructed objects deteriorate in this manner if money is not spent on their maintenance.

5. Constructed objects will be maintained if they are community-owned and essential to the community social system, or if a profit can be made or a loss prevented through money spent on the repair of privately-owned structures. Schools that are needed for the education of the children of a community will generally be repaired, regardless of the cost, because of their essential social purpose. But housing units, stores, and other privately-owned structures in a community will be maintained only if the cost of the repairs will be made up by increased profit from rental or resale because of the repairs, or if the repairs are essential to prevent an economic loss.

6. For example, an apartment house will be constantly repaired at great expense if: (a) a greater rent can be expected from each of its units that is large enough to more than pay for the cost of the repairs, or (b) the repair is needed to maintain the present rental income, to prevent loss of that income. Constructed objects that are privately-owned will be kept in good condition through continued repair whenever the cost of repairs results in increased profits or prevents an economic loss. Deterioration of houses,

stores, office buildings, and other privately-owned buildings in a community occurs when money spent on repairs will not result in one of these economic purposes.

7. Many communities are so economically unhealthy that they contain large areas of deteriorated buildings, and some communities die. In these communities, not a single constructed object can be economically maintained. This generally occurs when the primary construction object is abandoned, eliminating the source of employment, and the necessary market support for all of the objects, both community-owned, and privately-owned, in the community. The result of the economic death of a community is a "ghost town," an uninhabited area of deteriorated structures.

8. Constructed objects in a community may become economically unhealthy for a number of reasons. They might become unhealthy because of loss of their necessary support through reduced employment at the primary construction object, through change in employment resulting in the reduction of the number of workers in the economic level that the facility was constructed to serve, or through construction of new facilities of the same type but of a more desirable quality which drew away the support for the older facility.

9. Or, objects may become economically unhealthy because of a loss of locational value. That is, objects may be located to efficiently serve

their purpose but, later, because of community change, find themselves fixed to a location that is no longer desirable. For example, a local shopping center might be built at the intersection of two heavily-traveled streets. But the heavy street traffic might result in congestion, leading to the construction of a new street at a different location, in effect, removing the high volume of passing cars from the shopping center site that it needs for its support. When this occurs, the use of the shopping center decreases, as it is no longer easily accessible by a large number of cars, and with this decrease in use comes a decrease in profit. Such a decrease in profits cannot be prevented--or an increase in profits created--by money spent on repairs, as the cause of the decline in profit is a location that became unsuitable for local shopping business. The location would not be improved by repairs, so repairs would not be made, and in a short time the structures would be deteriorated.

10. A construction object may also become economically unhealthy and deteriorate because of loss of environmental values. That is, the nature of its surroundings might be such as to reduce its desirability. For example, the value of single-family housing units will generally be reduced if they are located near a railroad, major industry, or very heavily-traveled road, because the noise, smells, smoke, vibration, and danger to children created by these facilities reduces their desirability. With reduced desirability comes a reduced market for resale, as few people care to live where these

facilities have an effect on housing units, and a decrease in housing unit resale price results, because if they are to be sold, they must be less expensive than the exact same housing unit located in other areas that are not affected by such surrounding facilities. When surrounding facilities have greatly undesirable effects on housing units, resale market and sales price falls rapidly, resulting in the undertaking of few repairs, and the deterioration of the structures, for the expense of repairs will neither increase the market for resale or price of the units, nor prevent their continued loss of value.

11. As strange as it may seem, a great increase in land price will often result in an economically unhealthy condition leading to the deterioration of structures. This condition arises when land is already developed and a great locational advantage is created for use of the ground for a more profitable use, but the market for its redevelopment for that use is not strong enough to permit the purchasing of the existing buildings, their demolition, and the construction of the more profitable facility.

12. For example, low density housing units may have been built at the intersection of two service streets that became collector or arterial streets as the community grew, resulting in their location at a good site for local shopping center development, causing a great increase in the value of the land on which they are located. But there are many intersections of

this type in a community, not all of which can be used for local shopping centers because that many centers are not needed. The result of this is a greatly increased land value based on the site's potential for use for local shopping, but a market for local shopping facilities that will not support construction at the site.

13. The deterioration of the low density housing on this site results from the fact that taxes, money collected to pay for community services, are charged on the basis of the value of land and building owned, and that there is no resale market for low density housing at this site--the resale demand is for land only, for local shopping construction. The owners of the low density housing units are required to pay greatly increased taxes because of the great increase in their land's value, increasing their expenses, while no money spent on repairs will increase the sale price of the housing units, as they are only wanted in order to be demolished so their land can be utilized for a shopping center. Such low density housing units will generally be permitted to deteriorate until the community has grown sufficiently large to permit the construction of a local shopping facility on their sites.

14. The physical deterioration of constructed objects in a community usually results from: (a) a reduced market, (b) loss of locational value, (c) loss of environmental value, or (d) a great increase in land value for development for another use than that for which the site has been developed.

Deterioration of constructed objects in a community results in great economic loss to the community as a whole through deterioration of community-owned structures, as well as great economic loss to private individuals through deterioration of the homes, stores, and offices they own.

15. But deterioration losses are not the only economic losses suffered by the community through the process of community development. Great value is also lost through construction inefficiency, primarily in the abandonment or replacement of good facilities because they are no longer adequate to fulfill their purposes. A service street might be built, at great expense, to serve housing units along its path, only to be rebuilt a few years later as a collector street because the need for movement along the street has increased. The original expensive service street might well have provided its service for many years without added expense to the community, but because of community growth, the facility is discarded as inadequate and a new expensive collector street is built.

16. Similarly, a four inch water pipe might be laid, at great expense, in order to serve an area of the community that shortly becomes inadequate due to increased development requiring water service, resulting in the need for an eight inch water line. The expensive four inch pipe, being perfectly good and capable of providing its service for many years, is abandoned, and a new eight inch pipe installed at additional cost to the community.

17. In both of these cases, great value has been lost in the community as the community is required to pay for two roads and two waterlines, although only one of each facility is actually providing its service to the community. A more extreme condition exists in arterial street interchange construction, when developed property and expensive land must often be purchased by the community in order to provide this necessary facility, whereas the same ground could have been purchased earlier, undeveloped, at greatly reduced community cost.

18. Community costs resulting from both deterioration and inefficiency (costs from which no additional community services result), must be paid for by the citizens of the community in the form of taxes. Each landowner in a community pays a share of these costs that result in no economic return or social service. Community deterioration and inefficiency are economic illnesses that sap the economic strength of the community.

Illustrations:

1. Photo of a very old building in good repair
2. Photo of buildings needing minor repairs
3. Photo of buildings needing major repairs
4. Photo of dilapidated or collapsed buildings
5. Air photo of large area of deteriorated buildings (oblique)
6. Ground photos of Jerome, Arizona (ghost town)
7. Diagram of local shopping center before and after moving of road
8. Photo of trains at rear yard of houses (deteriorated)
9. Photo of smoke-belching factories next to housing (deteriorated)
10. Air photo of deteriorated housing next to central business construction, or at major intersection

Reading Assignment
Day 138 (continued)

Illustrations: (continued)

11. Photo of the demolition of deteriorated houses to clear a site for more profitable development
12. Photo of replacement of underground piping by larger pipes
13. Photo of tearing up service street to construct collector street
14. Photo of demolition of major structures to clear an area for an interchange

MANAGEMENT OF COMMUNITY DEVELOPMENT

Reading Assignment
Day 169

1. Community development that occurs without direction, that occurs without long range community forethought, often results in great community and private economic loss through deterioration and inefficiency. And it simply provides for the minimal social and economic needs of the community's population. It does not assure the development of the kind of community that its citizens want.

2. Most people do not want to live in a community that simply works. They want it to work well, to be economical in cost and efficient in use. They want a community that is personally satisfying, a community of which they can be proud. They want an attractive community, and a community with all parts not only accessible but in the best possible location to provide maximum service at the least possible cost. They want housing areas that are not only marketable and serviced by streets, schools, and shopping areas, but also that are so organized as to result in the most attractive and safest environment for the rearing of children, with all of their facilities loacted to serve their needs in the best possible manner.

3. These desires for the development of the community in a personally-satisfying, efficient, and economical manner cannot be fulfilled without forethought that results in actions that alter the pattern of community development, permitting these desires to be fulfilled. Forethought in action

is management. The management of community development is essential to the attainment of these community goals. As in all management activities, the management of community development requires planning, organization, and control.

4. The planning, organizing, and controlling of community development is guided by men specifically educated to fill this role, men with knowledge of community economic, social, and functional structure, who devote their lives to the improvement of communities. These men are professional City Planners. They are generally required to prepare themselves for this role through four years of college study before entering professional city planning study programs of two or more additional years. In general, at least six years of college, a Master's degree in City Planning, and a number of years' experience working with other City Planners in the management of community development are required before a City Planner is permitted to accept the responsibility for directing the management of a community development program.

5. In the process of planning for community development, the professional City Planner must first formulate goals, establish specific objectives, and set general community development policies. He must answer the question, "What kind of community is wanted?" He then must program his work to result in a series of actions causing the fulfillment of this want.

6. When these general goals, objectives, and policies are formulated, the City Planner must answer two more questions. These are "What exists in the community at present?" and "What will probably exist in the community in the future if development is not managed?". The answer to the first of these questions requires a complete description of the existing community, an inventory of all land uses and building, street, and utility locations, the capacity of present facilities, and the qualities of the present population. This information is essential to arriving at the answer to the second question above, as any answer will be very strongly influenced by the location and extent of existing facilities and the nature of the present population. The answer to this second question requires the forecasting of probable future community form and character based on existing conditions.

7. In order to determine the changes in the community that management of community development must cause in order for community goals to be attained, the community that will probably exist at a future date through unmanaged community development must be compared with that which is wanted in the community of the future. To do this, the planner must predict what the community will be like in the future if its development is not managed. The City Planner must predict the probable number of jobs in the community, the housing market, the need for community facility, utility, and transportation services, the location of deteriorated areas, and the probable location of all construction in the community. The predicted qualities and locations of constructed objects that are not desired in the future

development of the community are those elements that management practices must alter if the community goals are to be attained.

8. The City Planner then designs the community of the future, keeping those predicted elements that are desired, and adding those elements needed to fulfill the community development goals that will probably not be developed without management, resulting in physical plans for an economical, efficient, functional, and attractive community. He first postulates a solution-in-principle, studies alternative solutions, and then selects the best solution for further development. This selected solution-in-principle, giving just the broadest outline of the desired future community, is spoken of as a General Plan. The General Plan is used as a guide to direct the future detailing of the managed community development program. It is communicated through publication of a series of maps and reports explaining its logic.

9. Small study models of the future community are often made in order to permit the City Planner to study its three-dimensional qualities, and prototype neighborhoods, shopping areas, recreation developments, etc., are developed to assure that the general statements of policy in the General Plan can actually be realized in the development of specific areas.

10. The General Plan, being simply a general statement of community goals, must be further detailed before it can be realized.

Standards must be established for such things as street widths, school site sizes, the size and location of neighborhood parks, housing site sizes, and all other construction in the community. A first stage development plan must be created identifying those facilities that will be constructed and the uses that are to be controlled during the first few years of the management program. The total community cost of community-owned facilities to be constructed during this period must be estimated, and their construction scheduled to assure that they will be available where they are desired and when they are needed. The schedules for construction of these facilities and the manner in which they will be paid for is called a Capital Improvement Program, and a Capital Budget.

11. After a General Plan has been formulated and a first stage development plan has been detailed, the management of community development must be organized to assure that they will have their desired effect.

12. Organization for community development requires more than just the services of the professional City Planner. At the earliest stages of the community planning process, often before the City Planner is hired, a Planning Board is created. This board consists of a group of citizens selected to represent the people of the community, to express their desires to the professional City Planner and to assist him in formulating a plan that the citizens of the community will support. The Planning Board reviews the professional planner's proposals, suggests changes, holds public meetings

at which every citizen may express his views on the proposed plans, and suggests actions, to the elected public officials, which should be taken to enforce community development proposals. The elected public officials review the suggestions of the Planning Board, and pass ordinances influencing community construction.

13. After a General Plan is adopted by the Planning Board, the planner and the board propose laws that are needed to control community development in such a manner as to realize the first stage development plan proposals. These laws, written with the advice of a lawyer, include zoning ordinances, and subdivision control ordinances.

14. Zoning ordinances show the locations in the community where various uses are to be permitted, and areas where they are not to be permitted if the community's goals outlined in the General Plan are to be attained. Zoning ordinances also establish standards for such things as the location of buildings, their maximum height, and the use of property around buildings for parking and landscaping. A zoning ordinance, when made law through passage by the elected community officials, controls the general location, type, size, height, and specific siting of buildings in a community.

15. Subdivision control ordinances, when made law through passage by the community's elected officials, control the quality of land development. They specify standards for such things as property shape, street width,

facilities that must be provided by developers, maximum street slopes, general street patterns, and many other standards for land development.

15. But planning and organization are not effective without control. Laws serve no purpose if they are not enforced. For this reason, the community's building inspector and its Planning Board are given the power to enforce zoning and subdivision control ordinances.

16. The building inspector, whose job it is to see that every building in the community is safe for human use, is usually required to check the plans for every building proposed to be built in the community, to assure that it meets all the requirements of the zoning ordinances. No building can be erected in a community without a building permit, a certificate granted by the building inspector stating, in effect, that the structure is safe and meets all of the requirements of the community's ordinances. If a building is proposed that does not meet the requirements of the zoning ordinances, the building inspector will not grant a building permit and the structure cannot be built.

17. The community's Planning Board is usually given the power to review land subdivision proposals to assure that they meet the requirements of the community's subdivision control ordinances. When a proposed development does not meet these requirements, the subdivision plan will not be approved, and the site will not be developed as the approval of the

Planning Board is required before land can be legally subdivided and sold.

18. By means of the enforcement of zoning ordinances and subdivision control ordinances, and the use of a Capital Budget, community development is controlled to fulfill the goals of the General Plan. But these goals are never completely fulfilled, as the community constantly grows or changes, requiring that the General Plan be adjusted to fit the new conditions, and be pushed ahead further into the future, as first stage goals are attained. The management of community development is a continuous process.

19. The success of such a managed community development program depends on three essential factors: (a) a population desiring a better community and willing to support their elected officials in their efforts to bring it about, (b) a group of elected officials willing to adopt and demand strict enforcement of community development control ordinances, and (c) a professionally-trained, and experienced City Planner capable of forecasting, plan preparation, and drafting control ordinances that can effectively guide the development of the community.

20. Virtually every community in the United States of any significant size manages its community development. Communities provide themselves with the services of professional City Planners either through their employment on a full-time basis as a part of the community government, or as part-time private consultants. At present, there are more than 6,000

professional City Planners directing and managing community development programs in the United States.

Illustrations:

1. Photo of a city planner mulling over a map of a city
2. Photo of land use inventory map
3. Graph of population, present and projected
4. Photo of a General Plan
5. Photos of planning models
6. Photo of a Planning Board in operation at a public meeting
7. Photo of a zoning map and ordinance
8. Photo of building inspector reviewing a plan
9. Photo of a building permit on a building
10. Photo of a Planning Board reviewing subdivision with model
11. Photos of completely-planned communities: Reston, Virginia; Greenhills, Ohio; etc.

THE COMMUNITY AND ITS REGION

Reading Assignment
Day 170

1. Every community is a part of a region; it shares its characteristics with surrounding areas. It may be located in a large mountain valley, along a seashore, in an area drained by a great river, in a desert, in a mountainous area, or in the foothills near a mountain range. Because of its geographic location, a community will share many of its characteristics and problems with other communities situated in the same area. A community may be just one of many coal mining communities in a mountainous area, one of many resort communities along a seashore or in a desert, one of many lakeshore communities served by the same lake transportation facilities, one of many mountain valley communities served by the same interstate highway, or one of many communities at the side of a river that floods each year causing great damage.

2. Construction in the community is affected by the economic health of its region. When a region is prosperous, resulting in the creation of many job opportunities, many objects will be constructed and maintained in its communities to fulfill the needs of the workers required to fill these jobs. But when a region is economically unhealthy, the number of jobs decreases, construction in its communities ceases, and structures deteriorate.

3. The problem of the deterioration of a vast number of structures in a coal mining community in West Virginia cannot be solved by the

community's management of its own community development, no matter how well founded and supported its program might be, because the problem is not that of the particular community, but of the entire Appalachian coal mining region. The cause of the deterioration is a regional problem, requiring a regional response.

4. Many community problems can only be effectively solved regionally. The construction of highways for the movement of cars and trucks from one community to another within a region, and between regions, cannot be undertaken efficiently by each individual community along its route. Such highways must be planned as a complete regional system that must efficiently and economically serve all of the communities of a region. Similarly, the generation of electricity to fulfill needs for power is most efficiently provided by construction of a few large facilities, well-located to economically serve many communities in a region, rather than by the construction of hundreds of individual community power generation systems.

5. Protection from flood damage can be most effectively and efficiently provided through construction of regional flood control systems, rather than by hundreds of individual dams, levees, and open space reservoirs serving individual communities along riverbanks.

6. Just as community development is inefficient and results in great losses if it is not managed in the community interest, so also must regional development be managed if the full potential for the economic growth and

prosperity of the region is to be realized and if problems affecting the entire region are to be efficiently solved. Many states have state planning divisions employing regional planners to plan, organize, and control their regional development in order to assure the continuous creation of jobs for their citizens, resulting in a market permitting continued construction, and maintenance of constructed objects, and to solve problems related to the efficient provision of regional transportation, flood protection, and utility services.

7. All constructed objects in a community are related to all other constructed objects in a community, and to the region of which the community is a part. The community system of constructed objects is part of a regional system of constructed objects, each part of which must be needed, efficiently located, and sited on land permitting its economic development if it is to be constructed and maintained. The individual housing unit located on a service street in a small town is a part of an economic and social construction system that relates it to every other constructed object within an area of hundreds, and perhaps thousands, of square miles. This is the world of construction.

Illustrations:

1. Oblique air photo of small deteriorated town in West Virginia
2. High level air photo of interstate highway system covering a vast area
3. Photo of large power dam with transmission towers marching off into the distance
4. Diagram of regional flood protection system
5.

Reading Assignment
Day 170 (continued)

Illustrations: (continued)

5. Photo of regional planners studying regional map of state with models of new industrial plants in foreground
6. Oblique air photo of a vast urban region including a number of communities

UNIT VI

A CONSTRUCTION PROJECT